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LIGHTING "UNITS."

We have referred several times in the past few months to the somewhat chaotic condition of the rating of different electric illuminants, and the importance of reducing all these to the common basis of mean spherical candle-power. We have advocated this in common with the majority of those who have given this matter much thought, because the mean spherical candle-power basis seems to be the nearest to a satisfactory one that can be obtained, and not because it is the final criterion from which the expert illuminating engineer is to draw his conclusions in selecting an illuminant for any specific purpose. The watts consumed per mean spherical candle-power by any bare illuminant indicate roughly to the designer of illumination what may be expected from the illuminant when properly equipped for any particular piece of lighting. The final test which should always be applied by the illuminating engineer on important work is that of calculating the intensity of light delivered where it is wanted from the source of illumination properly equipped with shades, globes or reflectors. In other words, we are coming rightly to consider more and more the source of illumination, together with globes or reflectors, as lighting "units" rather than simply as sources of illumination without regard to the means which are taken to direct and diffuse the light. Indeed, so important has this point become that many manufacturers have within the past few years brought out lamps which are in reality lighting units, in which in order that there may be the least possible opportunity for users to equip wrongly the source of light, there is provided as a regular equipment a reflector and a diffusing globe. It is to be hoped that the day will come when manufacturers will not be obliged in self-defense to put out such lighting units, and that those responsible for the installation of electric lighting arrangements will be able to combine intelligently the source of light with the means used to direct and diffuse the rays, or in other words, to assemble their own lighting units from standard material on the market so as best to suit the conditions to be met. The series of articles by Messrs. Cravath and Lansingh which have been running in these columns for several weeks give much information which will enable this to be done in connection with incandescent lamps, for which the immense variety of shades, globes and reflectors is available.

An equal amount of attention has not been given by glassware and electrical manufacturers to the proper equipment of other electric illuminants. The matter has not been entirely neglected by any means, but should be more generally considered than it is. As pointed out by the authors, manufacturers of this kind of glassware might well give attention to combining the useful and the artistic to a greater extent than is usually done. That is, there are many very plain and homely shades and globes which are very useful on account of the way in which they alter the distribution of light about the lamp and which could be made easily decorative as well as useful. On the other hand, there are some purely decorative shades which could be redesigned so as to make them useful in altering the distribution of light as well. Such attempts to combine the useful and the artistic of the past have been confined mainly to manufacturers of certain patented types, but there is no good reason why this should continue to be the case, nor has there apparently been any good reason in the past save the indifference of both manufacturers and users. As more attention is now being given to the engineering of illumination, these points must be more considered in the future by manufacturers than in the past.

ELECTRICITY AND THE FARM.

It is both a surprising and disturbing fact that while electrical engineering has in recent years greatly benefited all classes of citizens, it has hardly done anything for the farmer. Dwellers in towns and cities receive the advantages of electric light, electric power distribution, electric traction, and electric transmission of intelligence. The only advantages that have been extended to agricultural districts and isolated farms have been in the direction of electric trolley roads and electric telephones. Even these advantages extend to only a small percentage of farms in the United States, and they hardly enter into the real activities of the farm. A considerable amount of energy is required annually in farming. It is not supplied by electric motors. It is supplied mainly by the dirigible quadruped, and partly by the itinerant steam-engine. Vast aggregate quantities of fertilizers are prepared and applied to farm lands, but electrochemical industries have not yet even entered the field. We live at the bottom of an ocean of nitrogen, containing a relatively small quantity of oxygen. The nitrogen in this aerial ocean is about 4 billion million tons (4×10^{15} tons) in total weight, and yet it is so difficult to fix a single ton of it in fertilizing form, that we have to depend upon bacteria to do most of the work in a slow and tedious process.

It is earnestly to be hoped that electrical processes may be developed to aid in some one of the manifold industries that find their home on the farm. The commercial value of any such successful processes might become enormous. The recently published report of the Secretary of Agriculture shows that the total money value of United States farm products for the year covered by the report was nearly 6½ billions of dollars, representing an average daily output of 17½ millions of dollars. The United States farms thus produced wealth at an average rate of not far from a million dollars each hour. Fifty-six per cent, or more than half of the total money value of the annual products of the country are farm products. Since the farming population is only about one-third of the total population of the country, this third produced more than half the total produce value of the country. During the past five years the total money value of United States farms has increased on the average by a hundred millions of dollars per month. Chemistry, botany, biology, meteorology and mechanical engineering are doing splendid work for the farmers. It is greatly to be desired that electricity should be enlisted in the same service.

MODERNIZING STORE LIGHTING IN SMALL TOWNS.

The owner or manager of the central station in a small town who thinks there are no more fields to conquer in electric store lighting because he has secured as customers all the stores in the town, can profitably set to work to broaden his view. Electric lighting, and especially incandescent lighting, in the stores in many small towns is undeniably crude and very far behind the times; in fact, is but a step in advance of the kerosene lamps it replaces, and the average electric light company has plenty of scope for a campaign toward modernizing and making attractive this branch of lighting. While the modernizing of the lighting of any particular store will not necessarily require much if any more power than formerly, it does mean that the rendering of the lighting attractive as well as useful in a few stores in a town will stimulate interest in electric lighting generally among merchants, and in the end be sure to result in greater consumption of power for store lighting. Furthermore, if there are some merchants in a village (and there usually are) who still stick to kerosene lamps, the difference between their lamps and the stores with modern electric lighting arrangements will be so much more marked than between kerosene and crude electric lighting as almost to force the adoption of electric lighting by the slower members of the mercantile community who have before held back from having their stores wired. The conventional method of electrically lighting stores by incandescent lamps in small country towns is now, as it was fifteen years ago, to hang a row of bare incandescent lamps on drop cords over the counter on each side of the store. The windows in which goods are displayed are illuminated with similar bare drop lights hung low in the window, rather than with lamps in reflectors concealed at the top of the window. So far as the illumination of the counters and shelves is concerned, the rows of bare lights give fairly good distribution of light, with perhaps more at and above the horizontal than necessary. The effect of the rows of bare lamps hung low is, however, not only crude, but detrimental to the general effect of the lighting.

The general effect can be improved immensely in such stores simply by the use of shades of frosted or other diffusing glass placed over each lamp. Even frosted bulb lamps alone would be a great improvement, both in artistic and illuminating effect. Going a step farther, the merchant, by spending a little more money to modernize his lighting, can substitute one-light pendant fixtures for drop cords, place the lights considerably higher above the counter, and use frosted lamps with any of the several artistic and efficient types of reflectors now on the market, thus throwing plenty of light down to illuminate counters and shelves and permit the sources of light to be placed high enough to be well out of the line of vision. If the merchant can be induced to spend a little more money on power for illumination in order to secure very much better effects, a good plan is to go almost to the ceiling with the incandescent lights, either grouping them on ceiling fixtures or studding the ceiling with them. In this case the use of reflectors which will give a downward distribution similar to that from a Nernst lamp is advisable. In modernizing store lighting, a change frequently made is to bunch incandescent lamps in clusters or groups. This should be done with much care, remembering that the bunching of lights in this way does not give as good and even a distribution of light over the store as the arranging of single lamps at frequent intervals. To have the illumination on the counters as satisfactory as it was before, when a few clusters or chandeliers are substituted for scattered lights either the total amount of light must be increased or the clusters must be equipped with lamps in reflectors mounted at such an angle that the lamps in the cluster will cast the maximum light in directions that will bring up the illumination midway between clusters to nearly that under each cluster.

SATURATION EXPRESSED IN PERCENT.

A suggestion is made by Mr. H. S. Baker, in our correspondence columns on page 1037, to define the percentage of saturation as the ratio of the intercept on the y-axis, by a tangent drawn at any point of the saturation-curve, to the ordinate through that point. Thus, if the tangent should cut the y-axis at half the height of the ordinate, the percentage of saturation would be 50 per cent, or 0.5. The advantage of this plan would be, as the communication points out, that if we subtract this ratio from unity we have the ratio of any small percentage increase in voltage to the percentage of additional exciting current producing it. If this method of expressing saturation were generally understood, it would be convenient on account of the above advantage. An objection is that it is very difficult to secure unanimity of usage in phraseology of this character. Consequently, ambiguity and misunderstanding are likely to follow such usage, because the engineer, not acquainted with the definition, is likely to suppose that the "percentage of saturation" means the ratio of the voltage actually attained to the maximum attainable with full-field excitation, either as permitted by the field-rheostat, or as attainable with large super-excitation. Possibly all danger of ambiguity might be avoided, and the defi-

niteness of the suggestion secured, by inverse method. Thus, it is possible to define the degree of saturation in the sense above defined, by stating that one per cent more exciting current will produce x per cent more generated voltage. Thus if one per cent more excitation produces, say, 0.4 per cent more voltage, the position of the tangent to the saturation curve is defined for the point considered, no matter what the scales of excitation and voltage may severally be.

SINGLE-PHASE RAILWAY ON LONG ISLAND.

A description of a short urban railway system which possesses the distinguishing characteristic of being operated exclusively by alternating-current, although covering the exact route formerly occupied by a direct-current railway, is given on page 1029 of this issue. The railway described may be taken as an example of an alternating-current traction system in its simplest form. A portion of the simplicity may be attributed to the fact that with the exception of the oil switches, no automatic devices are used on the cars, and no moving machinery is installed in the sub-station. The absence of automatic brakes with their magnetic or pneumatic devices renders the apparatus on each car only slightly more bulky than that necessary with direct-current equipments; for the accelerating rheostat there have been substituted a one-coil transformer, a preventive resistance and a preventive reactance. In comparison with the controller circuits used with a two-motor equipment operated on the series-parallel method using a variable resistance in series with the armatures, the controller circuits of the plain single-phase equipment are much simpler. The weight of the auxiliary devices on the single-phase car is somewhat greater than that of those used on the direct-current car, but that no trouble is experienced in finding room for these devices, even on small urban cars, is evidenced by the fact that the complete equipment for two 50-hp single-phase motors has been placed on a 14-ton single-truck car without any appearance whatever of crowding.

As viewed by a passenger familiar with direct-current railways, the system as a whole possesses few points to attract his attention. The cars are in general appearance similar throughout to those frequently seen upon city streets. The trolley-wire with its suspending catenary, and the trolley pole with its supporting porcelain insulators, give to the conducting system an appearance of stability never found in direct-current work, and these are the only features which serve to distinguish this railway from the usual urban systems. A study of the overhead work of this railway soon convinces one that, independent entirely of the extra expense involved in the insulation to withstand the higher voltage, the cost of the catenary cable, cross-span wires and substantial side poles renders the investment in the completed distributing circuits quite comparable with that necessary with the usual low-voltage direct-current trolley wire equipments. It is evident, however, that nothing less severe than a falling tree, a hurricane or an earthquake could disturb the overhead work, and that the expense for maintenance will be reduced to an insignificant figure.

MULTIPLE-UNIT CONTROL FOR SINGLE-PHASE EQUIPMENTS.

The advantage of the multiple system of control of motor cars with respect to rapid acceleration, and the incidental advantage of the motor car method of operating trains through the ease with which the individual cars can be handled in switching and the assurance that a train will not be rendered non-operative by the derangement of a single unit, have proved so great in direct-current practice that the absence of a similar system for use with alternating-current has been adduced as a grave defect of the latter system; and it has rather strangely been assumed by some that the multiple-unit system could not be applied to alternating-current equipments. The problem of producing a multiple-unit system for the control of cars driven by single-phase series motors does not, however, seem to possess any difficulties greater than those involved in direct-current equipments.

It can be taken as self-evident that all cars on which it will be desirable to use the multiple-unit control will be equipped with air brakes. No difficulty has been experienced in constructing single-phase motors for operating air compressors, and it can be assumed that a supply of compressed air will be available to operate multiple-control gear. It is probable also that pneumatically-operated and magnetically-controlled switches are as well adapted for alternating-current as for direct-current equipments, and even in direct-current practice the electromagnets for opening the air valves are supplied with current from an isolated storage battery circuit. It thus does not appear why the slight modifications which would be introduced in standard direct-current multiple-switch controllers in order to render them serviceable for alternating-current equipments should present any unsurmountable difficulties.

FREQUENCY METERS.

An interesting type of frequency meter for alternating-current circuits is described on page 1,029 of this issue. It depends upon the well known fact that the alternating-current strength which will flow through a given condenser under a given impressed voltage, increases directly with the frequency. Thus, at 2,653 volts, a one-microfarad condenser will take one ampere of current, if the frequency be just 60 cycles per second; whereas if we double this frequency, leaving the voltage unchanged in magnitude, the current in the condenser will be two amperes. Consequently, an ordinary ammeter in circuit with a condenser is a frequency-meter, if allowance be made for variations of voltage. Variations of voltage may, of course, mask and suppress the utility of such a device for indicating changes in frequency. The plan adopted in the article referred to compensates for changes of voltage by employing a separate dynamometer voltmeter coil to carry the scale; while the ammeter dynamometer coil carries the pointer. If the voltage remains stationary, the scale will thus remain stationary and the ammeter pointer will indicate changes of frequency in the ordinary way; but if only the voltage changes, the scale and pointer will each move in the same direction through the same angle, thus leaving the pointer over the same mark on the scale. By a simple union of these functions, the one moving coil points off changes in voltage, thus making a voltmeter and a frequency-meter out of the same instrument, and utilizing both moving coils.

A well known form of frequency measurer employs the principle of electro-mechanical resonance in such a manner that one out of a number of appropriately loaded springs, placed side by side, is electromagnetically excited into visible resonance. As the frequency changes, the resonance is shifted from one spring to another, in successive steps. Such a method does not permit of strictly continuous indications from one step to the next. The apparatus described in the article should, however, be capable of continuous indication throughout a considerable range. In a large distribution system, the measurement of frequency is not of great importance, because it is determined by the engine-governors in the central station or stations supplying the system. It is in experimental plants where the frequency is under control, and has to be adjusted, that a knowledge of the frequency becomes important and a special frequency-meter will be useful. The frequency is always to be had by determining the speed of the alternating-current generator; but a constant running tachometer is not easy to maintain and it is inconvenient to make frequent observations with a speed counter.

Struggle for Independent Telephony in New York.

The recent struggle to establish one or more independent telephone systems in New York city has led to some interesting developments. The proposal to use the old burglar alarm franchise of the Mercantile Electric Company, now owned by the United States Independent Telephone Company of Rochester, is said to have impelled Controller Grout and Corporation Counsel Delany to ask Charles E. Hughes, counsel for the Insurance Investigation Committee, to investigate the facts concerning the reported sale of the franchise by interests identified with the Equitable Life and the Mercantile Trust Company. For some time the Controller's office and the Corporation Counsel's office have been looking into this franchise, which was granted by the old Board of Electrical Control to enable the Mercantile Safe Deposit Company to perfect a burglar alarm service. The city officials were informed that the Mercantile Trust Company had disposed of the Mercantile Electric Company for $5,000 to the New York Independent Telephone Company, which in turn is owned by the United States Independent Company. Then they received bankers' circulars announcing that the United States Company was floating a $25,000,000 bond issue largely on the strength of this franchise, which the company valued at $12,500,000.

Controller Grout at once set to work to find out whether the Mercantile Trust Company interests had sold the franchise for $5,000, or whether the United States Company was placing an absurd value on the franchise when it estimated it to be worth $12,500,000. President Paul Morton of the Equitable was appealed to to investigate the sale of the franchise because of the fact that the Equitable Life owns the Mercantile Trust Company, and, therefore, would be a heavy loser if the company had sold for $5,000 a franchise worth in reality $12,500,000.

President Morton issued the following statement last week concerning the franchise sale: "The Mercantile Electric Company was incorporated some years ago, with a special charter or franchise which gave it permission to lay wires in the Subway of New York, and to do a general burglar alarm and telephone business. The stock is entirely owned by the Mercantile Safe Deposit Company." The fact that President Morton asserted that the franchise gave the right to do a general telephone business attracted general interest. The Controller and the Corporation Counsel also were interested in President Morton's statement that the stock of the Mercantile Electric Company is owned entirely by the Mercantile Safe Deposit Company. The New York Independent Telephone Company, on October 7 filed with the Secretary of State and also with the County Clerk a certificate of merger with the Mercantile Electric Company. The papers on file state that the merger was effected September 27 of this year, and that at that time the New York Independent Telephone Company owned all the stock of the Mercantile Electric Company.

Allowance for Plant Depreciation.

A number of interesting decisions by the Massachusetts Gas & Electric Commission were quoted recently in these pages, Hon. F. E. Barker, chairman, has now given out another, in the unanimous decision of the board upon the petition of the city of Holyoke for a change in the method of reckoning the annual depreciation of its plant so that the city will not have to charge off 5 per cent a year. The board dismisses the petition. The decision is in part as follows: On December 15, 1902, the city of Holyoke took possession, under the general law, of its gas and electric light plant. The total initial expenditure for this purpose was $829,252.21. Since that time the city has expended for additions and improvements $267,722.94, making a total investment in the business up to the present time of $1,096,975.15. Nearly all the cost of the original purchase and of the subsequent additions and improvements has been defrayed out of the proceeds of bonds issued by the city. Of these bonds $98,200 have already been paid, $36,600 become payable in 1906, and the same sum annually for the seven years following, with a smaller amount annually thereafter until 1932. The interest payments for the year 1906 amount to $28,185.50, the demand for this purpose obviously decreasing steadily with the payment of the bonds as they mature. Interest upon practically the entire debt is at 3½ per cent per annum. During the year covered by the last return the income derived from private consumers exceeded the operating expenses, not including interest or depreciation, by about $40,000. The estimates for the year 1906, as submitted at a hearing at Holyoke, gave:

Operating expenses	$230,781
Bond payments	36,600
Interest charges	28,185
Depreciation at 5 per cent	54,849
Amount to be provided	$350,415
Deducting estimated income, not including anything for city lights	$228,000
To be raised by taxation	$122,415
Bond payments	36,600
To be raised by taxation for maintenance	$85,815

It was urged at the hearing that to include the last-named amount in the tax levy would impose upon the taxpayers an unreasonable and unnecessary burden and that the city was entitled to relief accordingly.

In the conduct of a business of this character the municipality and the taxpayers seem to stand clearly in the place of a private company and its shareholders, while the relation of the consumers to the owners of the property is not changed. The consumers must bear the full burden of carrying on the business, including the cost of depreciation. The consumers, however, as such are not to be assessed to pay for the plant, and they are not interested in the time or manner in which the money representing the original investment is called for from the taxpayers. Whether the city's debt on account of the plant is large or small does not concern them.

As a fair depreciation charge is for the proper protection of the owner's interest, he is primarily interested that its amount should be ample. The fact that the owner is obliged to expend at the same time a large sum on his investment can be no reason for reducing it; it may rather emphasize the importance of keeping it at a proper amount. It seems clear to us, therefore, that the amount of the bond payments ought not to be considered as material to the question of the fair amount of the depreciation charge.

Included in the total investment of $1,096,975 is approximately $110,000 paid for the expense of litigation and $45,000 paid for plant, which was shortly after abandoned and replaced by appliances of a modern and more efficient type. These two items indicate an impairment of the investment already incurred of about $155,000, and constitute an obvious depreciation for which provision should at some time be made. In any well-regulated business law expense is an operating and not a capital charge. Some additional amount is annually accruing from causes common to all enterprises of this character. The sum already named is so large, however, that if the statutory rate of 5 per cent be required and the depreciation now going on be taken at no more than the 2 per cent suggested by the city, it will require five years from this date, or eight years from the purchase of the plant, to restore the amount already lost. Nor will the 5 per cent requirement be unreasonably burdensome upon the city. It will, in fact, require the inclusion in the tax levy of a somewhat less sum for maintenance than is involved in the suggestions originally presented by the city, as the following figures will show:

Suggested by the city—	
For operating expenses	$230,781
Interest on bonds outstanding	28,185
For operating and interest	$258,966
Deduct receipts not including city lights	228,000
Leaving a balance of	$30,966
Depreciation at 2 per cent	21,999
Making a total to be put in the tax levy for maintenance	$52,905

Since the hearing the estimate for operating expenses has been materially reduced and the figures resulting from this and the board's finding will be as follows:

For operating expenses	$196,281
Interest on the entire investment at 3½ per cent, as required by law	38,394
For operating and interest	$234,675
Deducting receipts not including city lights	228,000
Leaves	$6,675
Add depreciation at 5 per cent	54,849
Net for operating and depreciation	$61,524
Deduct from this the difference between the interest to be collected $38,395 and $28,185 the interest to be paid, or	10,209
	$51,315

That is to say, with a continuance of the present prices to private consumers the city, as a consumer sharing with them the consumers' obligations, will pay for its lights in the public buildings and streets the sum named.

Changes in National Electrical Code.

The fourteenth annual meeting of the Underwriters' National Electric Association was held in New York on December 6 and 7 to consider changes and additions to the National Electric Code. The recommendations of the committees on car wiring, double and single-pole switches, high-tension motors, switches and cut-outs, rheostat specifications, wiring and construction of fan motors and flexible tubing, were all adopted. The committee on double and single-pole switches adversely reported to the suggestion that no single-pole switches be allowed and that double-pole switches be used in every instance. The committee on switches and cut-outs recommended only one change, and that was in connection with switches designed for use on Edison three-wire systems, which must hereafter be marked with both voltages, followed by the ampere rating and the words "3-wire," as for example, "125-250 v., 30 a., 3-wire." The recommendations made by the committee on high-tension motors were mainly relative to the proper insulation of the machines and wires leading to them. The suggestions for the proper rating of variable-speed motors were referred to a committee.

Among the decisions were that the casings of all transformers in central or sub-stations must be permanently and effectively grounded through conductors having a carrying capacity not less than No. 4 B. & S. gauge, except in the case of series transformers for instruments; a committee was appointed with power to provide rules relative to these latter instruments. Transformer secondaries of distribution systems may be grounded at the transformer or on the individual service, as provided in the Code. When transformers feed systems with a neutral wire, the neutral must also be grounded at least every 250 ft. for overhead systems and every 500 ft. for underground systems. Mr. Dow, of the Detroit Edison Electric Company, cited cases in which this rule would be unfair, and a committee was appointed to consider his suggestions. The ground wire in direct-current, three-wire systems and alternating-current systems must hereafter never be less than No. 4 B. & S. gauge. Over especially inflammable stuff water-proof sockets must be used. This provision is not made because of the water-proof quality of the socket, but rather on account of the superior and special construction of this socket.

The rule providing that the insulation of transformers when heated shall withstand continuously for five minutes a difference of potential of 10,000 volts alternating between primary and secondary coils and between the primary coils and core, has been changed so that the time now is one minute in order to agree with the rule of the American Institute of Electrical Engineers. The suggestion that the rule for switches, cut-outs and circuit-breakers should be modified so as to require no protective devices on the switch in the neutral of three-wire systems, and the resolution passed by the National Conference that "in cases of three-wire systems with ground neutral a solid connection without fuse be permitted on the neutral wire," were referred to a special committee for action. It was felt that this suggestion was so important and would make such a radical change in all rules in force to-day that the change should not be made except after mature consideration. The suggestion emanating from Mr. Willcox, of the General Electric Company, to amend the rules so as to allow the use of series lamps was referred to a committee who were instructed to report as soon as possible.

Hereafter under the head of "General Suggestions," as printed before the Code proper, will appear a suggestion urging upon architects the necessity for properly providing for signaling system wires in modern buildings, with suggestions also as to the proper methods of accomplishing this. The suggestion that a committee be appointed to consider special rules for the equipment of electric cranes was approved. No action was taken on the suggestion that outlet boxes be required at all outlets, and the recommendation that the grounding of secondaries be made mandatory met a similar fate.

Analyzing the Brooklyn Municipal Plant Report.

Considerable space has been given in the last two issues of this journal to the report of the experts of the city on the proposed municipal lighting plants for Greater New York and the discussion of the subject at the meeting of the Municipal Engineers. A novel and excellent way of bringing the data home to the public at large has been hit upon by the Edison Electric Illuminating Company, of Brooklyn, in regard to that part of the report which relates to Brooklyn Borough. A full-page advertisement has been inserted in the *Brooklyn Eagle*, giving all the figures of the report, and then analyzing and discussing them. It is a good piece of work, and as a means of appealing to the intelligence and sound common sense of the community, its value cannot be overstated. As will be remembered, two plans are proposed, one more ambitious and comprehensive than the other, each, however, involving, on the actual figures presented, a loss to the borough, as compared with the cost of the service from private companies. The estimated losses are $27,000 and $68,000, but it is claimed that the real losses to the city would be much greater, in one case being $257,390, and in the other $525,820.

Moreover, the first plan is discussed as follows: "The plan proposes running lines through 494 miles of streets, of which 156 miles will be supplied from underground and 338 miles from overhead construction. The average distance between poles in overhead construction of this character is 90 ft., which makes it necessary to place not less than 58 poles to the mile. This will involve, therefore, for the overhead construction, the erection of not less than 19,604 additional poles throughout the various streets of the Boroughs of Brooklyn and Queens. At a time when private companies are, in co-operation with the city authorities, taking down thousands of poles annually and removing many miles of overhead wires, the erection by the city itself of 20,000 additional poles can hardly be regarded as a public benefit." As to the second, large plan, it is pointed out that it proposes running lines through 1,004 miles of streets, of which 256 miles would be supplied from underground construction and 748 miles from overhead. This would involve, for the overhead construction, the erection of not less than 43,384 additional poles throughout the various streets of the Boroughs of Brooklyn and Queens.

The Allis-Chalmers Steam Turbine.

On Tuesday a large party of engineers inspected, by invitation, the 5,500-kw Allis-Chalmers turbine in course of installation in the Williamsburg power station of the Brooklyn Rapid Transit Company. Mr. A. M. Mattice, chief engineer of the Allis-Chalmers Company, was present to explain to the visitors the special features of the turbine, the upper casing of which was removed to facilitate inspection. An account of the Williamsburg station appeared in the issue of September 23, and on another page of the present issue the new turbine is described in detail.

The points which interested visitors in particular were the details of securing the blades, the shroud rings protecting and stiffening the outer ends of the blades, the low-pressure water packing arrangement, and especially the low-pressure balancing arrangement with its ingenious labyrinth or baffling packing. All of these details are described in the article on page 1042.

Not far from 100 engineers and other invited guests were present, among whom were the following: General Manager Frank Hedley, Chief Engineer George H. Pegram, Mechanical Engineer John Van Vleck, and Mr. George E. Thomas, Interborough Rapid Transit Company; Superintendent of Motive Power H. G. Stott, Interborough Rapid Transit Company; Chief Engineer M. G. Starrett, New York City Railway Company; Mr. Willis Lawrence, Manhattan Street Railway Company; President Edwin W. Winter, Vice-President and General Manager J. F. Calderwood, Electrical Engineer C. E. Roehl, Superintendent Motive Power C. F. Baker, Mr. A. Wolff and Mr. Geo. H. Howard, Brooklyn Rapid Transit Company; Constructing Engineer George A. Orrok and Chief Engineer J. D. Andrew, New York Edison Company; General Manager W. F. Wells, Brooklyn Edison Company; Mr. D. S. Kohler and Mr. W. A. Donkin, Allegheny County Light Company, Pittsburg, Pa.; Mr. Herbert W. York, chief engineer, American Smelting & Refining Company; Mr. H. A. Lardner, J. G. White & Co.; Mr. Geo. H. Throop, Mr. Martin H. Kilgour, London, England. The Allis-Chalmers Company was represented by Mr. W. W. Nichols, vice-president and secretary; Mr. A. M. Mattice, chief engineer; Mr. F. C. Randall, manager New York office, and Messrs. John S. Lord, C. J. Larson, A. G. Christie, Harry Byrne, A. F. Rolf, Frederic D. Herbert, C. A. Hoppin, S. G. Stone, H. W. Rowley, L. C Marburg and Samuel Moore.

United Engineering Building.

The accompanying illustrations give a perspective view and floor plans of the United Engineering Building, New York City, the gift of Mr. Andrew Carnegie to the American Institute of Electrical Engineers, the American Institute of Mining Engineers and the American Society of Mechanical Engineers. The construction of the building is proceeding satisfactorily, having reached the third floor, and in the absence of labor troubles it should be ready for occupancy next fall. The building is on West Thirty-ninth Street, in the rear of the Engineers' Club Building (which is now constructed to the sixth floor), and covers five city lots, with a front of 125 ft. and a depth of 100 ft. Only 85 per cent of this area is, however, covered by the building, or 115 ft. frontage and 90 ft. depth.

The first floor (Fig. 2) is devoted to general purposes. Fig. 6 is the plan of the floors containing the working offices of the representatives of the founder societies. The reception room, board and committee rooms are on the desirable south front and are favored by the windows which look to the eastward. Other floors (Figs. 3, 4 and 5) contain a number of meeting rooms and auditoriums. The largest of these, primarily designed for the meetings of national societies and for those of other large bodies, has been made to accommodate 1,000 persons (Fig. 3). The location of this large auditorium is on the first floor above the street, so as to make elevator service for it unnecessary. A large foyer and generous corridors give ample space for withdrawal from the large assembly hall. To enable those in the back of the auditorium to see clearly such diagrams and illustrations as may be on the stage, the seats are arranged on a grade, which arrangement enables coat rooms to be provided, opening from the outer corridors. The large auditorium floor is reached from the great central rotunda on the street floor (Fig. 2) by generous stairways, and can also be reached from carriages entering the driveway and moving continuously as they receive or discharge their passengers. The room for preparing apparatus and exhibits for the stage is conveniently served by a large freight elevator, so that heavy machinery and apparatus can be easily handled.

On the floor above the large auditorium are two assembly rooms (Fig. 4) occupying the principal portion of the area. These assembly rooms may be used independently for lecture purposes, or one may be made auxiliary to the other and used as a foyer or conversation room. Two rooms adjoining may be used in common when desired, as, for instance, for purposes of general reception or conversazione. Auxiliary smaller rooms on this floor are provided and provision is made for the service necessary for light refreshments or luncheon.

On the next floor above (Fig. 5) several small lecture halls are provided suitable for ordinary meetings of scientific and engineering societies, and for meeting of sections at the time of general conventions of national organizations. It is expected that there will be a great demand, especially for the small meeting rooms, for scientific purposes. They will be supplied with electric current, with compressed air and with gas and water. The meeting rooms of all sizes will be fitted for the use of the projection lantern. The board rooms of the society floors will be large enough for the holding of small professional meetings when occasion may require.

A crowning detail, in the planning of the building, has been the provision on the two upper floors for the libraries of the various societies (Fig. 7). The consolidation libraries of the several societies will form a working and reference library of the highest possible value as respects engineering science and practice. The top floor is to be devoted to working alcoves, to rooms for photographic reproduction and for drawing and similar library work. The roof will be specially constructed to secure the best illumination. The floor below the library reading rooms will be devoted to the book stacks, although when first the societies enter the building the alcove construction in the floor above will probably take care of the greater part of the nucleus of the future library which the societies will bring with them. This will leave the book stack floor to provide for future accessions. It is believed that, by the co-operation of the New York Public Library on the adjoining block, and with the interest and strength which the societies can add, the library in the Engineering Building can in time be made the most important engineering library of the country.

The building is also to furnish office accommodation for a large and continually increasing number of societies which have engineering or some other department of science as their principal object, such, for example, as the New York Electrical Society, Society of Naval Architects and Marine Engineers, Heating and Ventilating Engineers, American Gas Light Association, National Electric Light Association, Society of Chemical Engineers, Association of Edison Illuminating Companies, etc. For these organizations the building will offer office areas of varying sizes, the arrangement of which will be adjusted to the requirements of the tenants. Such participants will have use of the auditoriums.

A driveway (Fig. 2) gives access on the street level and under cover to the freight elevator, for boxes of books and other merchandise moving inward, and for mail sacks moving outward. This

FIG. 1.—PERSPECTIVE VIEW OF UNITED ENGINEERING BUILDING.

driveway also serves for carriage access to the auditorium and passenger elevators, and affords facilities for unloading by gravity to the coal pockets of the heating plant without handling. The general convenience of the building is also served by a receiving and shipping office at the rear, through which all goods in and out will be handled. There will be a bureau of information, at the right of the main entrance, where general questions can be answered, visitors directed, and some routine business transacted. This office will also be the location for the telephone exchange, the telegraph and the sub-postoffice.

By a business arrangement formed under legal advice and forming part of the deed to the property to the east of the building, a restriction has been placed which prevents the erection on that lot of a building more than 60 ft. high. This restriction runs with the land and secures light and air for the building on its eastern front above the third floor. The westerly wall is built 10 ft. within the property line, so that openings for light and air will always be left on that side and on the rear, even if high buildings should be hereafter built on adjoining property to the west and the north. The building will be given a finished appearance on all four sides and not merely on the south façade, in order that its monumental character may be seen and recognized from every point of view.

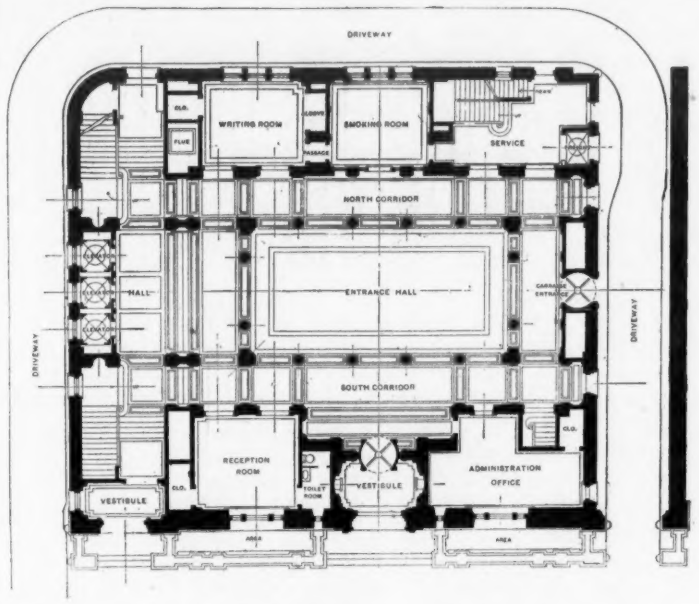


FIG. 2.—PLAN OF ENTRANCE OR FIRST FLOOR.

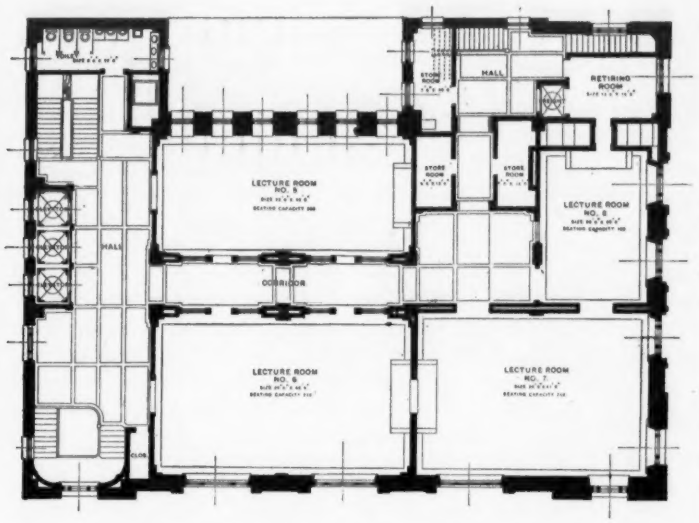


FIG. 5.—PLAN OF LECTURE HALLS OR SIXTH FLOOR.

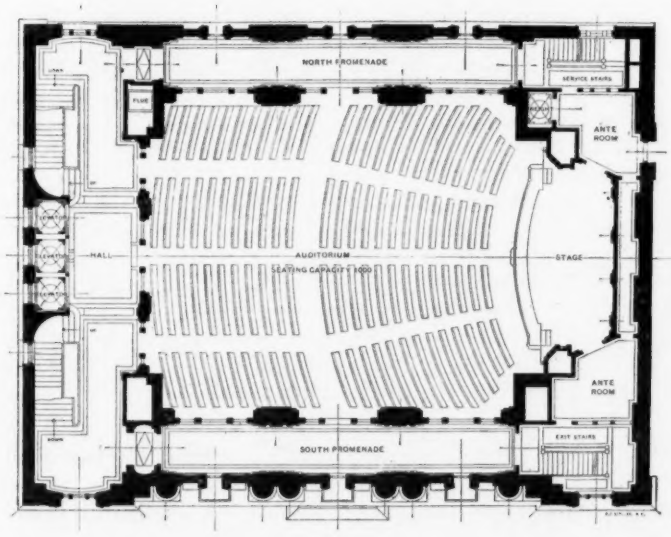


FIG. 3.—PLAN OF AUDITORIUM OR THIRD FLOOR.

FIG. 6.—PLAN OF ELECTRICAL ENGINEERS OR TENTH FLOOR.

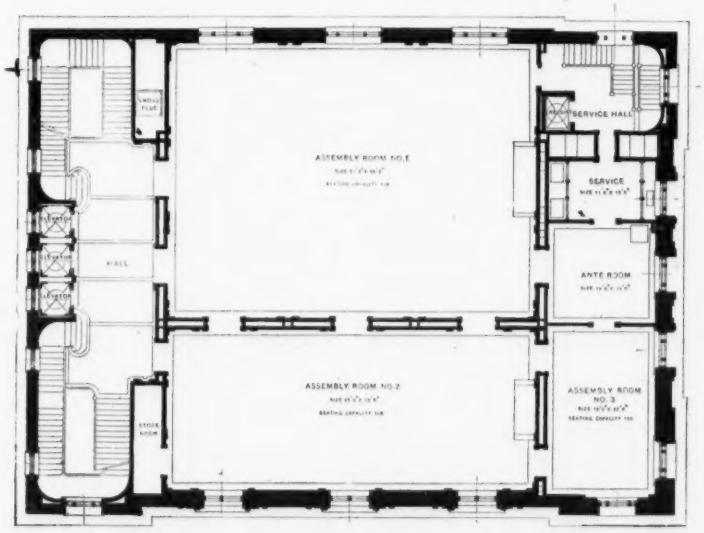


FIG. 4.—PLAN OF ASSEMBLY OR FIFTH FLOOR.

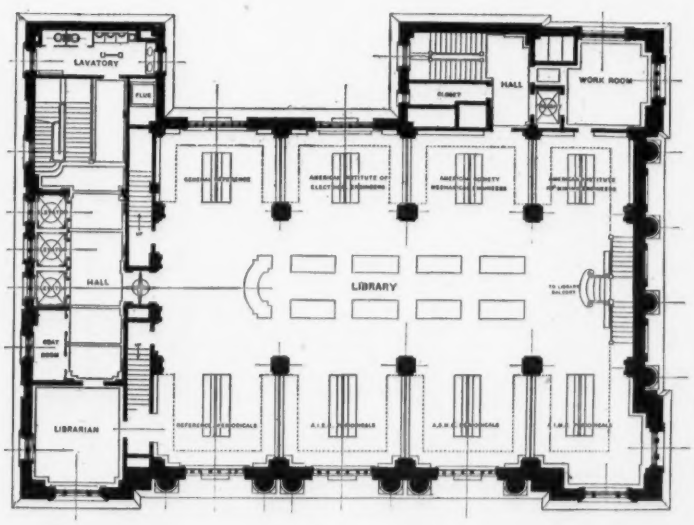


FIG. 7.—PLAN OF LIBRARY OR THIRTEENTH FLOOR.

UNITED ENGINEERING BUILDING.

Power and the Waterways.

The American section of the International Waterways Commission, consisting of Col. O. H. Ernst, U. S. A., chairman; George Clinton and George Y. Wisner, in its annual report to the Secretary of War on the progress made in the work, devolving on the commission, calls attention to a number of questions, which have been brought before it, and asks for an expression of the wishes of Congress for its future guidance. Among the questions referred to are the following:

The uses of waters at Sault Ste. Marie for power purposes and their regulation necessary to insure an equitable division of the waters between the two countries and the protection of the navigation interests.

The uses of the waters in the Niagara River for power purposes and the regulations necessary to insure an equitable division of the waters between the two countries and the protection of Niagara Falls as a scenic spectacle.

The advisability of building controlling works at the outlet of Lake Erie, including the effect upon the levels of the lakes and upon their shores, and upon the River St. Lawrence.

The effect of the Chicago Drainage Canal upon the levels of Lakes Michigan, Huron, Erie and Ontario and upon the River St. Lawrence.

Since it completed its organization in September last the commission has made progress in the collection of data bearing upon some of these questions, particularly those relating to the use of water at Niagara Falls, and to the regulation of the level of Lake Erie by works near its outlet. The commission on October 28 adopted the following resolution:

"Resolved, That this commission recommends to the Government of the United States and Canada that such steps as they may regard as necessary be taken to prevent any corporate rights or franchises being granted or renewed by either Federal, State or Provincial authority for the use of the waters of the Niagara River for power or other purposes until this commission is able to collect the information necessary to enable it to report fully upon the "conditions and uses" of those waters to the respective Governments of the United States and Canada."

The most pressing question, according to the report, related to the use of water at Sault Ste. Marie, where the traffic through the canals constructed at the Rapids, is said to be larger this year than ever before, it being estimated that the tonnage will exceed 40,000,000 for the year. The quantity of water which will be required in the operation of the canals will be greater in the future, and in granting privileges the respective Governments should not forfeit the right to increase the amount indefinitely. In this connection the commission has adopted the following resolution: "Resolved, That in the opinion of this commission, no further rights or privileges should be granted or conferred regarding the uses or diversions of the water flowing out of Lake Superior, by either the Government of the United States or Canada, until all data and information are in the hands of the commission that may be necessary to enable it to make suggestions for regulating the excess of these waters, or that, if such rights or privileges be granted, they be subject to any regulations that may be adopted by both Governments." The use of water for power purposes, the report points out, must be so regulated as not to affect injuriously the level of Lake Superior, and the level must not be allowed to fall so low as to injure navigation or raised so high as to submerge the shores."

Referring to the authority granted a certain power company to divert water from St. Mary's River above the rapids, and calling attention to the conditions imposed, one of which is that the company shall operate "in accordance with any rules and regulations that may hereafter be recommended by any international commission," the report points to the regulations prescribed by the secretary of war in granting permission under the act for the diversion of the water, with the statement that these regulaions probably will be used by the commission as a basis for regulations to be recommended. Their fundamental principles, which the commission believes to be sound, are that levels must be maintained, that navigation must be protected, and that the public must reserve the right to use any portion or all of the natural flow. After a public hearing given to the parties in interest in this connection, the commission tentatively adopted certain rules and regulations, and the report adds: "The enforcement of these rules and regulations calls for the executive action from time to time of an international commission. The enforcement of rules to be established hereafter at other places or upon the subjects will probably likewise require joint executive action. It is not clear from the language of the law creating this commission that Congress intended to provide for a permanent international board. It is desirable that the status of the present commission as a permanent executive board be defined, or a new board be created."

Work of the U.S. Bureau of the Census.

The annual report of the United States Department of Commerce and Labor recommends that the Bureau of the Census be given authority to take up the following subjects:

1. A five-year report on the electrical services, street railways, public power stations, telephones and telegraphs, etc., in lieu of the ten-year reports now authorized.

2. A report on savings banks, co-operative savings institutions, home-building associations, and similar fiduciary organizations for the promotion of individual thrift.

3. A report on life, fire and marine insurance.

4. A report on the fisheries industry, in co-operation with the Bureau of Fisheries.

5. A compilation of the results of the several State censuses of population taken in 1905.

6. A report covering the judicial statistics of the several States, covering the indictable offenses recorded in the court dockets and the disposal of these cases.

The director of the census also calls attention to the popular desire for a continuation of the Eleventh Census report on mortgage indebtedness, but he hesitates to recommend it on account of the large expense for field work. He refers also to the demand of the agricultural interests for a five-year census of live stock, a report which is urgently recommended by the secretary of agriculture. This report also, if authorized, will involve a large increase in the regular appropriation for the continuance of census work.

The electrical reports of the Bureau are at present on a ten-year basis, except that on electrical manufacturing, which is included in general manufacturing, the statistics for which are required, by act of Congress every five years.

Three-phase Traction for the Simplon Tunnel.

Confirmation has been received in this country of the report published in our last issue that the Swiss Government has adopted the Ganz three-phase system for the Simplon tunnel and that the installation will be ready for service May 1, 1906. To provide the necessary equipment the Italian Government has agreed to furnish temporarily five electric locomotives made for the Valtellina line. It has been found that these locomotives are large enough for the conveyance of the heaviest trains.

This decision is a result of an investigation of the working of the Valtellina line by a commission of officials representing the Swiss Post and Railway Federate Department, the General Director of Federate Railways and the Federal Commission for the study of Electric Traction; Engineers Boveri and Thormann were also members of the commission.

The commissioners, twelve in number, traveled on a special train hauled by an electric locomotive at a speed of 20 miles per hour on the line Lecco-Lierna. The weight of the train was 400 tons. At Lierna a transformer-substation was inspected. From Lierna to Colico the speed with a train weighing 250 tons was 40 miles per hour. Then, on the line of Colico Morbegno and back the multiple-unit system with two electric motor-cars each at the ends of the train with a total weight of 300 tons, was tested with load differences of a maximum of 10 per cent between the two motor cars.

From Colico to Chiavenna, on the long line with steel gradients, starting tests were made with a train standing still with a total weight of 240 tons which train was dragged by an electric locomotive. On the following day the commissioners ascertained on the same grades and descents by means of a directly reading wattmeter the power derived from recuperation, which with a train of 247 tons gave a mean value of 273 kw and a maximum value of 456 kw. On the same day the Ardenno bridge and the hydro-electric central station at Morbegno were inspected, which terminated the visit on

the Valtellina line. On the next day a run with a special train was made on the line Milano-Porto Ceresio, with motor-cars on the multiple-unit system, and a visit was made to the sub-station of Gallarato and the central station of Tornavento. The shops at Lecco were inspected for the purpose of examining the motors dismounted and in order to judge about repairs and operating expenses incurring.

The Swiss engineers examined into every detail and during the trial runs ascertained personally the loads of the trains, the operation of the motors and apparatus, and the taking of records in the dynamometric car, thereby satisfying themselves as to the accuracy of the traction tests which were a complete success.

The Cunard Turbine Steamer "Carmania."

Great interest has naturally been aroused by the arrival in New York harbor of the new Cunard liner *Carmania,* fitted with Parsons steam turbines for the propulsion of her three screws. She is in general respects a sister ship to the *Caronia,* whose arrival here in the spring was noted in these columns. She is 672 ft. 6 in. over all, with a gross register of 19,524 tons and a displacement of 30,918 tons. Her boilers have a capacity of 21,000 indicated horse-power, and the steam pressure is 195 pounds per square inch, the turbines taking steam at an initial pressure of 150 pounds. There is a general saving in weight by the adoption of the turbines of about 5 per cent. The high-pressure turbine is on the center of the three shafts, and one combined low-pressure and astern turbine on each of the two wing shafts. The appearance or effect is curious. It is apparently an engineless engine room; but there are many elements that help fill up the space. All the auxiliaries are driven by reciprocating engines, except where one or two electric motors are used. There are about 1,115,000 blades on the turbines; the longer blades of the low-pressure turbines are bound together by two circumferential strips laced with copper wire and soldered. The screw shaft speed is 185 r.p.m.

The electrical equipment, in the orlop deck aft of the engine room is occupied by four generating sets, each of 75 kw capacity, running at 450 r.p.m. There are about 3,000 incandescent lamps. From the main switchboard run 36 circuits, 16 for ship lighting, 10 to the thermo tanks and ventilating fans, three to the electric heaters, three for the motors on the turbine lifting gear in the engine room, two for the boat hoists and one to the searchlight projector. The lavish use of electric heaters is quite noticeable. There are 4 in the main saloon, of 20 amp. each; 2 in the writing room, 2 in each of six staterooms, and 1 in each of the first-class bathrooms. The second size take 7 amp. and the smallest 5 amp.

Motors are to be seen all over the ship. In the engine room there are three, each of 18 brake hp, for lifting the turbine cases and rotors. On the boat deck are two electric winches with warping drums for lifting the ship's boats. In the storerooms on the lower deck three electric hoists handle supplies for the galleys and pantries. One 500-pound hoist of 3.5 brake hp, and one 300-pound hoist of 1.56 hp supplies the first-class galley, while a similar one is located in the third-class galley and pantry. These motors with their controllers are all on the lower deck. A 200-pound coal hoist is placed in one of the vent shafts from the stokehold, to raise coal for the first-class galley. In the mail sorting room, aft on the upper deck, a 4-hp motor, lifting 500 pounds at 150 ft. per minute, is employed for delivering the mails to the mail room on the orlop deck.

The electrical equipment of the galleys and pantries includes one dough-mixer for the bakehouse, one roaster for the first-class galley, one dish-washer for the first, second and third-class pantries, one grid in the first and second-class pantries, the bridge deck service pantry, the promenade deck service pantry, the first-class smoke-room bar, and the officers' pantry. In addition to these there are three knife cleaners. The first and second-class barbers' shops are provided with an electric hair brusher and a one-gallon electrically-heated hot water urn. Small fans are provided for the chief engineer's cabin, engineers' mess, doctor's and first-class barber's shops and at other points. There is also a very complete telephone system and a submarine signaling equipment, as well as a regular Marconi wireless outfit. The turbine outfit had a severe test on the outward trip, and underwent the ordeal splendidly. The storms encountered were tremendous, but the usual vibration was reduced to a minimum.

Opening of New York Electrical Show.

The Electrical Show, which is to continue until December 23, was opened in Madison Square Garden on December 12. Temporary Chairman George A. Miller, Jr., secretary of the exposition company, introduced Prof. G. F. Sever, of Columbia University, Director of Exhibits, who delivered a short address of welcome. President Roosevelt, in Washington, opened the show. The moment Prof. Sever finished his address the news was flashed to Washington over a special wire, and Mr. Roosevelt pressed a golden key, placed for the occasion in the White House. The Presidential pressure completed the circuit, which started the machinery of the exhibits and turned on the numberless lights in the Garden. The golden key, which is the property of Gen. E. S. Greeley, of New Haven, Conn., has been used before on several similar occasions, and is highly prized by its owner, who was present at the Garden.

As a matter of fact the show, while interesting, is not greatly of technical interest, but is intended rather for "popular consumption." Between forty and fifty exhibitors have spaces, the most conspicuous and beautiful of which is that occupied by the Bell Telephone local and long-distance companies. This in reality is the only telephone display. The General Electric, Westinghouse, Crocker-Wheeler, Sprague, C. & C., Stanley and other large corporations are conspicuous by their absence. But there is enough to amuse and dazzle the public for a couple of weeks, and some of the more technical exhibits are worth inspection by engineers, such as those of the "Inter-pole" motors, the long Moore vacuum tubes, the electric heating and refrigeration displays, the Gray telautograph and the Poulsen telegraphone, the De Forest wireless telegraph system and the Ovington lecture experiments in the concert hall on high frequency. We shall return to the subject in our next issue.

Electrical Engineers of the Times.—XL.

MR. WILLIAM L. WATERS.

William Lawrence Waters was born in London, England, on September 7, 1876. He was educated at St. Dunstan's School, London, and entering the London University, in 1893, was graduated in electrical engineering at the head of his class in 1896, and in mechanical engineering in 1897. During his course at the London Uni-

MR. WILLIAM L. WATERS.

versity Mr. Waters did considerable research work in pure physics, and the results of which were embodied in papers on "Variations in the E.M.F. of a Standard Clark Cell," "Absolute Determination of the Ohm," "A Mathematical Investigation of the Cooling of a Short, Hollow, Poorly Conducting Cylindrical Shell with Walls of Appreciable Thickness." These papers were presented before the London Physical Society, the British Association for the Advancement of Science, and the Royal Society.

After leaving the University, Mr. Waters spent one year in the shops of Hosking Brothers, marine engineers, London, which he left to enter the engineering department of Siemens Bros., Woolwich. Here he spent three years, having charge of alternating-current design during the last year.

In January, 1901, Mr. Waters came to the United States and entered the engineering department of the Bullock Company, Cincinnati, as assistant to Mr. B. A. Behrend. In February, 1902, he became connected with the National Electric Company, of Milwaukee, at that time the Christensen Engineering Company, as chief engineer. In this capacity Mr. Waters has designed a large number of direct-current and alternating-current generators and motors and transformers. Among the more important machines built by the National Electric Company during this time are a 1,500-kw, 6,600-volt alternator for the power plant of the St. Louis Exposition; two 1,000-kw rotary converters for the Milwaukee Electric Railway & Light Company; four 1,000-kw motor-generators and four 1,000-kw frequency changers for the Union Electric Light & Power Company, St. Louis.

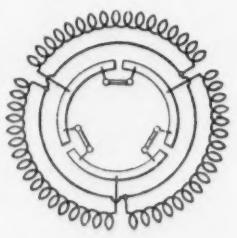
Mr. Waters' engineering ability has shown itself not only in his electrical designs, but also in the fact that he is the designer of a steam turbine with which the National Electric Company has been experimenting, and which is giving promising results. Mr. Waters is a member of the American Institute of Electrical Engineers and a contributor to its *Transactions*.

CURRENT NEWS AND NOTES.

TELEPHONE SUBWAYS.—A lecture illustrated by lantern slides will be given by Mr. E. V. Cox, on December 20, before the Engineering Society of Columbia University, New York City, in room 203 of the Engineering Building. The subject is "Telephone Subways," and a general invitation is extended. The hour is 8.15 p.m.

NON-RESIDENT LECTURES.—Mr. J. M. S. Waring, of Chicago, gave a lecture before the Senior electrical engineers at the University of Minnesota upon "Storage Battery Engineering," on December 5, 1905. Mr. Waring outlined the principal uses of the storage battery, discussed the methods of operation, booster, and the advantages of the battery as a central station auxiliary. As a concrete example of storage battery engineering, Mr. Waring discussed the reasons for the adoption of storage batteries by the Elevated Railway companies in Chicago, and followed out in some detail the method of determining the location and method of handling the same.

MAGNETITE AS A RESISTANCE MATERIAL.—Among the conducting materials having a negative temperature resistance coefficient, the ones possessing the most remarkable characteristics seem to be the tetroxid of iron or magnetite, or a mixture of magnetite and chromate of iron, the latter having a higher initial resistance than the former, but being equally conductive at high temperatures. In a patent issued December 5 to Dr. C. P. Steinmetz it is stated that these substances are chemically stable and structurally solid even at a red heat, while the resistance of magnetite at red heat is about one per cent of its resistance at ordinary temperatures. The

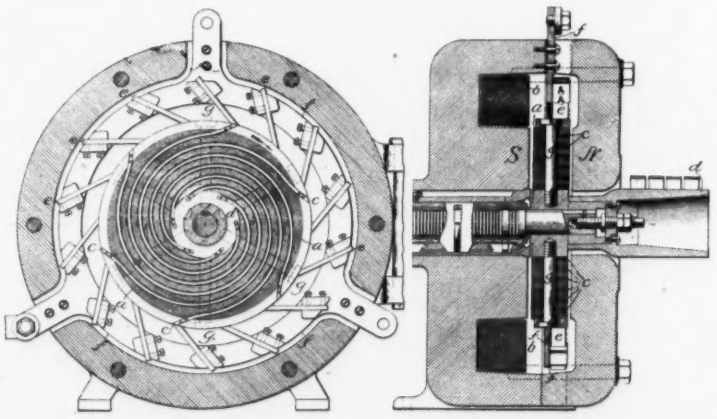


patent describes the use of these substances as self-reducing starting resistances for direct-current, series-wound and shunt-wound motors and for induction motors. The illustration shows a method of using the resistance in the secondary circuit of an induction motor. The secondary coils are in three sets, all connected at one end to a short-circuiting ring, and each at the other end is joined to a segment of a second short-circuiting ring. The gaps in this latter ring are bridged by magnetite resistances, and the effect of this construction is to check at first any rush of induced current in the secondary, but gradually to allow the current to increase as the speed of the motor increases and the resistances become heated.

SUBWAYS AND BUILDINGS.—The collapse of a part of Charing Cross Railway Station, London, has been attributed to the subway roads in the vicinity. Sir Benjamin Baker, consulting engineer to the Southeastern Railway Company, says that the snapping of a tie rod was undoubtedly the cause of the accident. Sir Benjamin, who is also consulting engineer to the Baker Street & Waterloo Railway, in an interview scouted the idea that the tunneling should be in any way responsible for the catastrophe. He pointed out in this connection that the Baker Street & Waterloo tunnels run at a depth of no less than 80 ft. below the surface of the roadway. "Of course," he remarked, "London is being honeycombed with these tunnels, but up to the present I have not heard of a single case of serious accident or subsidence during the tunneling operations connected with these lines." Mr. John Belcher, president of the Royal Institute of British Architects, expressed a very different opinion. "Undoubtedly the tunneling which is going on in London for the new tube railways must affect the stability of the buildings," he said. "I know that the engineers of these tubes say that it is not so, that the construction of these tubes renders them really as solid a foundation as the earth, and to a certain degree that view is true, but the danger arises from the diversion of the water under the soil. These burrowing operations drain off that water and open up new courses for underground streams, and that is what brings about the mischief. We have had a proof of it in the case of Queen Victoria Street."

TELEPHONY IN NEW YORK.—The Great Eastern Telephone Company, which proposes to cut almost in two the present telephone rates, made public last week the officers and directors of the organization. Mr. Reynolds, one of the organizers of the company, has been in the telephone business for years. He is president of the Coast Line Telephone Company, vice-president and manager of the State Line Telephone Company, manager of the Atlantic Telephone Company and treasurer and director of the New York Electric Lines Company, all of which companies practically have been absorbed by the new concern, as far as operation is concerned. The company intends to have 600,000 telephones in operation. It has a 99-year contract with the Inter-Ocean Telephone & Telegraph Company for itself and sixty associate independent telephone companies controlling long-distance business, New York, New Jersey, Pennsylvania and the West. Its circular states that contracts for service to the amount of more than $1,500,000 have already been signed and that there will be 200,000 subscribers before the preliminary canvass is completed. The capital stock of the company is announced as composed of 300,000 shares, 200,000 of which have been subscribed for or are contracted to be issued.

UNIPOLAR GENERATOR.—The illustration herewith shows a modified form of Faraday's disc used as a generator as proposed by Mr. H. H. Wait in a patent issued December 5. The machine is of the radial type, in which a disc is arranged to rotate in an annular field of force concentric with the disc, through which the lines pass transversely. The inductors consist of copper bars embedded in



channels in the face of the disc and disposed generally in spiral grooves from the center to the edge of the disc. Collecting brushes are provided, one set of brushes resting upon a copper ring at the periphery of the disc, and the other set upon the collector ring or shaft. The e.m.f. generated in the inductors is exerted radially, and its value for each inductor is independent of the shape of the spiral, being proportional to the product of the total magnetic flux and the rotative speed of the disc. The inductors are placed in the spiral form in order that the current which flows therethrough may set up a field of force in a direction to assist the magnetization of the main field coils and thus give to the machine a compounding effect.

AN INDEPENDENT BUTTON.—The National Interstate Telephone Association has just issued a lapel button of the badge of the independents, showing the familiar shield. This is also made up in clasp pins and hat pins, and has been bought largely by managers of local exchanges for distribution among their employees and subscribers.

NEW YORK ELECTRICAL SOCIETY.—The 255th meeting of the New York Electrical Society will be held at the American Institute, 19 West Forty-fourth Street, Wednesday, December 20, at 8 p.m. Mr. J. M. Waldron, signal engineer of the Interborough Rapid Transit Company, will deliver a lecture on "The Signal System of the New York Subway." The lecture will be illustrated with lantern slides.

MILITARY SEARCHLIGHTS.—Orders have been issued by the United States War Department providing that searchlights at military forts shall not be thrown in night drills upon any vessels except those provided by the Government for artillery purposes. It is ordered that if a light is thrown upon any other vessel it shall be removed as soon as it is discovered that the vessel is a private one, or as soon as an alarm whistle is blown. This order is to prevent any interference in the navigation of vessels.

PUBLIC POLICY.—Mr. Arthur Williams, chairman of the committee on Public Policy of the National Electric Light Association, has begun the active work of this committee by sending out a copy of the first *Bulletin* of the Anti-Municipal Ownership League to every member company in the association, together with a letter calling his attention to the desirability of adopting special measures for the widespread publicity of more correct information than is generally obtained on the subject of municipal ownership.

LECTURE ON RESUSCITATION.—Under the auspices of the Hudson River Electric Power Company there was a gathering at the office of Dr. D. L. Kathan on Union Street in Schenectady, N. Y., last week. Those present included the heads of departments of the company and its allied and auxiliary companies at Mechanicville, Spier Falls, Utica, Schoharie, Watervliet, and the meeting was arranged by Brice E. Morrow, manager of the Electric Power Company. Dr. Kathan delivered an interesting discourse on the best and most modern methods of resuscitating a person who has received an electric shock, and also on the treatment of persons who have received electrical burns. The lecture was illustrated with a living subject. It is proposed to have similar lectures in the future for the instruction of the staff and employes of the companies interested.

POWER FACTOR METER.—It is well known that the phase position of the current with respect to the e.m.f. in alternating-current circuits can be ascertained by finding the voltage across a resistance in series with the receiver, the voltage across the receiver itself and the vector resultant of these two voltages. The simple calculations for determining the power factor are based on the assumption that the current in the circuit is in phase with the voltage across the resistance. An application of this method forms the basis of a patent issued December 5 to Mr. Joseph L. Routin, of Lyon, France. As a substitute for a simple resistance the inventor uses a series transformer supplying current to a secondary circuit in which is connected a non-inductive rheostat. A third coil on this transformer supplies to the voltmeter an e.m.f. in phase with the primary current. This e.m.f. is adjusted to equality with a certain portion of the receiver e.m.f. obtained from taps on an auto-transformer. The vector sum of these two equal e.m.f's having been obtained, the power factor can readily be calculated.

COAL MINES ON WHEELS.—In an interview last week Mr. Edison said: "The first great change in the production of electricity will abolish the carrying of coal for that purpose," he said. "Instead of digging gross material out of the earth, loading it on cars and carrying it, say, 500 miles, there to put it under a boiler, burn it, and so get power, we shall set up plants at the mouths of the mines, generate the power there and transmit it wherever it is needed by copper wires. It is preposterous to keep on putting the coal mines on wheels. It is too clumsy. It is too costly. There is no necessity for it. It is easier to carry molecular vibration—millions of waves a second—than freight cars full of crude matter. We can ship a 100,000 hp over a wire quicker and more economically than we can send the equivalent in coal over a railroad track. An Englishman told me a little while ago that he intended to set up a power station on the Thames, bring down coal by barges and sell electric power to London. I said to him, 'How foolish! Why not run a copper wire between London and the coal mines and develop your power where the coal is? If you build that power station it will be obsolete inside of fifteen years.' We must eliminate the railroad altogether from this problem."

WESTINGHOUSE INSPECTION TRIP.—A party of about 75 electric railway managers and consulting engineers from all over the Middle West was gathered at Indianapolis on December 9 as guests of the Westinghouse Electric & Manufacturing Company to inspect the single-phase railway of the Indianapolis & Cincinnati Traction Company in which there has been so much interest. T. P. Gaylord, manager of the Chicago office, brought in the largest party, which numbered 58, all of which were guests of the company, from Chicago, in three special cars, leaving Chicago at 8.40 p.m. the evening before and joining other small parties from Detroit and Cleveland at the Claypool Hotel in Indianapolis for breakfast. After breakfast a multiple-unit train of two single-phase motor cars was in readiness to take the guests to Rushville, where the power house and shops were inspected and full opportunity was afforded to investigate the equipments and details of maintenance. In the evening a theatre party was given, after which late trains were taken home. The party consisted of a fine representative body of representative interurban railway owners, managers and engineers, who much appreciated the opportunity to visit the road and the courtesy of the Westinghouse interests in planning and carrying out such a pleasant excursion.

ELECTRICITY FROM GARBAGE.—United States Consul-General Guenther, of Frankfort, furnishes the following description of a plant recently erected at Zurich, Switzerland, for disposing of the city's garbage by burning, the heat engendered being utilized to manufacture electricity. The consul-general says: "The plant is located in the outskirts and contains twelve furnaces, which are capable of burning 120 metric tons of garbage in 24 hours. The wagons loaded with garbage are lifted by means of an electric derrick upon a platform above the furnace into which the garbage is dumped. As garbage, however, does not burn easily, an electric blower injects a strong current of air which has been heated by passing through the flues in the furnace walls. The heat engendered by the burning of the garbage is sufficient to make steam in two large boilers at 8 atmospheres superpressure. The steam is used in the usual way to operate the dynamo. The electric power produced is used first for the purpose of the plant and to supply part of the power for the electric railroads of the city. Complete combustion of the garbage does not take place. From 30 to 40 per cent of its original weight remains in the form of slag. This slag, by mixing with lime, is used for making bricks and paving blocks. The plant is said to be paying well."

"AUTOMATIC GIRLS."—After a siege of "Frenzied Finance," the popular *Everybody's Magazine* is now devoting its energies to "frenzied science." This is one of its productions in that category: "Allentown, Pa.—Look it up in the atlas. Things of great pith and moment are being done there. A telephone exchange without telephone girls is in operation there. If the experiment does not fail girls will be banished gradually from "central" throughout the telephone districts of eastern Pennsylvania—of the whole country, perhaps. So much hangs upon Allentown. It may not be any of our business, but we do not sympathize with this exclusion act. The 'hello girl' may sometimes be a little less polished than Lady Clara Vere de Vere, but think of the everlasting jangling, the jumping of her nerves, the large percentage of pig-like people she has to deal with, the imperious impatience of the public, the gruffness of men, the occasional lapses of women telephoners from angelic sweetness. The innate and impenetrable stupidity of men loves to wreak itself upon the 'hello girl.' We have found her much more amiable and intelligent than most of her detractors. At the most she is only guilty of peeping into a novel or chewing gum. We like to think that she is pretty. Anyway, to supplant a girl with some sort of miserable, clicking, automatic machine is a mistake, probably a crime. Still, what is the use of complaining? They will be having automatic girls the next you know."

WIRELESS IN MEXICO.—The Mexican Government has requested the Telefunken Company, of Berlin, to establish for it a wireless telegraph system between S. Jose del Cabo and Maquallan, a distance of 325 km. across the sea.

TELEPHONE AND PHONOGRAPH.—U. S. Consul-General Guenther reports that Mr. Hans Starcke, of Eberfeld, Germany, has just obtained a patent for a device by which a phonograph is connected with a telephone. Even should nobody be present when a telephonic call is made, the words are recorded upon the phonograph and can be repeated ad libitum at any time. The idea is not new in America.

CENTRAL STATION ACTIVITY.—The *Central Station List,* issued by the McGraw Publishing Company, furnishes in many ways a vivid picture of the lighting and power industry, although to many it may seem a mere compilation of names and figures. It may be noted, for example, that in the March and September issues of the *List* no fewer than 3,306 changes of data were necessary, and the names of 392 new plants were added. Since September, 1904, there have been added to the *List* the names of 756 new plants, or plants most of which are new, a few others had not been in previous editions, and others had risen to central station dignity.

THE MONT BLANC RAILWAY.—U. S. Consul Keene, of Geneva, notes that work for the construction of the railroad to the summit of Mont Blanc has begun. The line, already mentioned in these columns, will be built like the Jungfrau line in the Bernese Oberland, Switzerland (system Guyer-Zeller). It will have a total length of 19 kilometers (11 4/5 miles) and will, it is hoped, be completed within five or six years. From the Fayet to the last station (via Chamonix, as there is already a railroad between the Fayet and Chamonix) the fare will be 100 francs ($19.30), and the trip will require four hours. The carriages will be heated and lighted by electricity, and the train will be composed of an electrical locomotive and two saloon cars, made to accommodate about 80 people. A special arrangement of the windows will permit all travelers indiscriminately to enjoy the scenery. Three kinds of powerful brakes, independent of each other, will be attached to the cars, thus rendering all accidents impossible. The telephone will be established along the line and will connect any point thereof with the head stations.

TECHNICAL EDUCATION OF THE XXTH CENTURY.—In an address with this title delivered on Founders' Day, Nov. 30, at the Thomas S. Clarkson Memorial School, Potsdam, N. Y., Mr. John Cassan Wait laid stress upon the desirability of an engineer possessing something more than a mere technical education. The twentieth century education should not only cultivate the courage and capacity of a man to cope with nature, but should give him some insight into the laws, institutions and systems of society. It should embody artistic treatment in structural work and in mechanical contrivance—a relaxation from the intensely practical and economical to a study of what is pleasing and what is beautiful. Some have an idea that there is not much that is beautiful in the mechanical and industrial. Nothing is further from the truth. It is for the twentieth century education to impart the beautiful and artistic to the useful, to lend inspiration and give expression to the deeper feelings of industrial life, its burdens, its struggles, its rewards and its glorious victories. The twentieth century should make its technically educated men something more than mechanicians, something more than the mere directors of processes. Men and women should be taught to vary their employment and to seek recreation in the profitable exercise of their intellectual faculties. The spirit of man needs more than gain, more than crowning success of its efforts, more than the applause of fellow men; it needs the hope and cheer of the life everlasting.

ELECTRICITY IN SULPHUR.—According to a newspaper account, Mr. Clarence White, of the University of Illinois, has conducted a series of experiments which have led him to believe that there is a close relation between electricity and sulphur. It is stated that the idea was suggested to him by observing that the color of an electrical discharge and that of burning sulphur are similar, but he had previously been aware that a current could be produced by heating two dissimilar elements such as copper and sulphur, and that in every instance a sulphide, sulphate or sulpheret is formed, and that the resultant action produces an electrical current. To illustrate the theory he said that if a particle of sulphur is placed on the end of a wire and placed in a Bunsen flame, a galvanometer connected with the other end of the wire will be deflected. The results of his experiments have led Mr. White to conclude that sulphur is an important factor in producing electrical energy and that possibly sulphur will be found to be a constituent of heat as well as electricity. He believes, however, that there is some other element which combines with sulphur at certain temperatures to form electricity, which may be oxygen, radium or some other known or unknown element. He thinks the discovery will lead to a production of cheap and powerful batteries whereby automobiles, balloons and yachts may be driven. Since Mr. White has apparently segregated electricity as a form of matter, it would be interesting if he would determine its specific gravity.

METEOROLOGICAL RESEARCH.—Prof. Willis L. Moore, the chief of the Weather Bureau, in his annual report, has the following to say regarding the Mount Weather Research Observatory, the establishment of which was begun at Mount Weather, Va., three years ago. "In order to prosecute the researches contemplated at Mount Weather, we have established there a plant especially adapted to atmospheric research. By means of balloons and kites the temperature, moisture and movement of the air at great heights will be ascertained. The absorption of solar heat by the atmosphere will be measured by means of the pyrheliometer and actinometer. The dissipation of solar light and heat will be determined by the polariscope. The special analysis of the sunbeam will be carried out by means of the bolometer and spectrometer. The electric conditions will be determined by means of the electrometer, and the radioactivity or ionization of the air, by means of the dissipation apparatus of Ebert. To all this we have added apparatus for studying the relations to the atmosphere of the magnetism of the earth, the temperature of the soil, and even the motions of the earth as shown by the seismographs. All these phenomena have been shown to have a more or less intimate connection with meteorology. In so far as aerial research may require it, sounding balloons will be liberated from many of the Western stations, in co-operation with those at Mount Weather, since it is considered very important to know the condition of the atmosphere above the land every day of the year to the greatest attainable height, especially during the passage of storms and cold waves."

TROLLEYS IN SPAIN.—U. S. Commercial Agent Price, of Jeres de la Frontera, states that a correspondent in Gloucester, Mass., recently wrote to him inquiring as to the advisability of building an electric tramway in that place, but the correspondent failed to sign his name. In response Mr. Price writes as follows: There is one old-fashioned wagon, drawn by three slow mules which makes five or six trips a day from the railway station to one of the public squares, a distance of about three-fourths of a mile, and sometimes goes through the principal street to the fair grounds, a distance of one and one-half miles. It carries 600 to 800 passengers daily for a 5-cent fare. If the car was a clean and attractive carriage there would be a great increase of passengers. The streets here are wide and level, with a solid rock foundation. There is no need of ballast. All the work necessary would be laying the ties and spiking down the rails. I think the road could be ready for the cars for less than $2,000 per mile. The city of Jeres and Santa Maria and other towns would give a subsidy of $30,000 or $40,000. The company could issue its bonds for 75 per cent, and their stock for the same amount per mile as the bonds. It seems as if this is an opening for American skill and capital. It would be a great improvement for these cities and bridge the gulf from ancient Moorishdom to modern times. There are several small towns within a distance of eight or ten miles that have no connection by rail with Jeres. There is now a projected railroad from Jeres to two other towns. Surveys and estimates have been made, but no constructing company has yet been found. It is certain that the installation of electric tramways would be attended with most favorable results in the interests of Jeres by establishing closer connections with adjoining towns with which there is now no means of travel and transportation. A tramway of 25 miles could be built which would connect three very important towns and furnish available means of travel to passengers from other towns in this province.

Electricity and Sewage Disposal.

AMONG the more recent developments of the use of electrical power is the installation of a complete electrical power transmission scheme extending from Birmingham (England) down the valley of the Tame for a distance of about six miles. The object of the scheme is to enable the Birmingham, Tame and Rea District Drainage Board, for which the work has been done, to pump sewage up to a strip of land adjacent to and situated at a higher level than the main conduit which conveys the sewage from the outfall works within the city of Birmingham to the sewage farm located in the Tame Valley and extending from Birmingham to Curdworth. The Drainage Board's estate comprises a total area of 2,830 acres, nearly 2,000 of which are used for irrigation, the remainder being land unsuitable for irrigation or land occupied by roads, streams, buildings, tanks, cottage gardens, etc.

Apart from pumping sewage the power transmission scheme is employed to drive motors at various places along the valley, to drive sewage screening rakes, sludge elevators, sewage distributors, workshop appliances, farmyard machinery, lighting, etc.

The contract for the entire undertaking was provisionally let to the British Thomson-Houston Company, Limited, of Rugby, England, in July, 1901. As, however, the scheme involved the erection of a destructor by the city of Birmingham on land belonging to the Board, Parliamentary powers had to be obtained before the undertaking could be proceeded with, and, owing to various difficulties encountered, which delayed Parliamentary sanction, but which were not connected with or incident to the scheme itself, it was not until June 19, 1904, that the contract was finally confirmed and the work begun. The plant is now in full operation, and when the fact is taken into consideration that besides the destructor a generating station and five brick pumping stations with provision for a sub-station in each, five miles of overhead line with crossings underground under public roads, together with the complete equipment of the generating station, sub-stations and sundry machinery on different parts of the estate were involved, it will be apparent that no time has been lost in carrying out the undertaking.

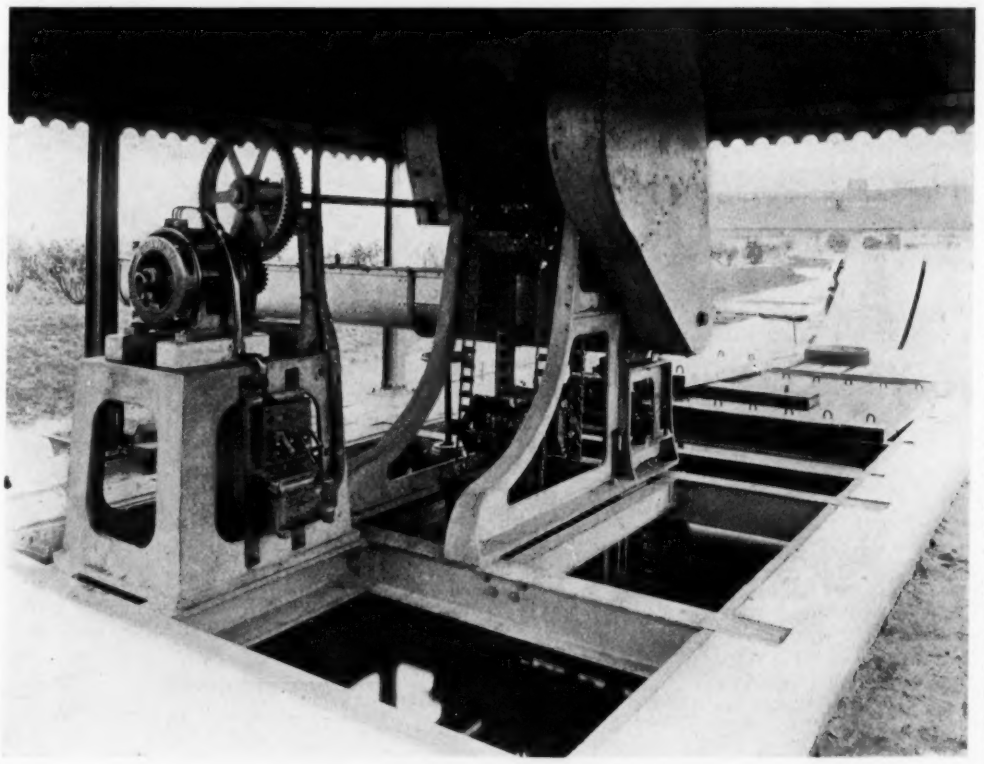


FIG. 1.—MOTOR-DRIVEN SEWAGE ELEVATOR.

The generating station is situated near the Saltley boundary of the Drainage Board's estate. It contains two British Thomson-Houston 115-kw alternating-current generators, each of which is coupled to a high-speed Belliss & Morcom engine. The generators are designed to give their output at 2,250 volts and 50 cycles, each generator being fitted with a direct-connected exciter so that the unit is self-contained. A small direct-current steam set of 15 kw, 220 volts, is also installed in this station. This latter set is used to operate a number of enclosed arc lamps on the sewage beds at Saltley, to light the station and, in case of necessity, to excite the alternating-current generators. The steam is supplied to the engines from Lancashire boilers combined with the destructor which is adjacent to the generating station.

The destructor, as before mentioned, was erected by the city of Birmingham, and steam is supplied to the Drainage Board under an arrangement with the authorities of the city of Birmingham. Thus the cost of power required is reduced to a minimum by the utilization of material that would otherwise be valueless.

The destructor is lighted throughout from the generating station, and there are two alternative systems of lighting—one from the direct-current side, and one from the alternating system of supply from the main generators; in the latter case suitable transformers being provided in a transformer chamber under the generating station to reduce the pressure from the primary 2,250 volts to 220 volts, which is the pressure of the lighting circuits.

The main switchboard bus-bars are connected to the overhead line by means of three high-tension cables separately supported from the walls of the generating station by heavy porcelain insulators and led up to the outlet, which consists of three separate porcelain outlet tubes built into the wall. Through these tubes high-tension insulated cables are led, and connected outside on shackle insulators to the overhead line, which consists of hard-drawn copper of special high tensile strength, supported throughout its entire length by high-tension insulators of the triple petticoat type. The section of the copper in the overhead line is so graded that a drop in pressure of only 7½ per cent over the whole line is obtained at maximum load. Throughout the length of the overhead line a barbed wire is run on the top of the poles and earthed at frequent intervals for protection against lightning. In all cases where the overhead line enters or leaves a building lightning arresters of the alternating-current type have been installed.

For the underground road crossings a special form of steel terminal poles has been designed, on the top of which is fitted a dividing box into which the high-tension overhead wires are led, and there connected to a three-core high-tension cable, which is led down the inside of the pole and brought out at the bottom into the connection box. The cable from this point is laid in solid bitumen to the steel terminal pole on the opposite side of the crossing, where it is connected through another dividing box to the high-tension line; it then proceeds overhead up to the next crossing. The other poles are of creosoted wood and are set in concrete on account of the soft character of the soil in which they are planted, most of the land having been until comparatively recently, and in some cases still being, under irrigation.

From the generating station the line proceeds to the Drainage Board's Saltley farm. At Saltley the line is tapped and led into a sub-station which is a portion of the old farm buildings converted for the purpose.

This sub-station contains three 5-kw transformers, which supply power to three 2-hp motors driving sewage screens, and one 8-hp motor driving farm machinery through a countershaft, and for lighting the offices and works manager's house. The 2-hp motors for driving the screens are 200-volt, 50-cycle machines, running at 1,420 r.p.m. and are connected to the screens through spur reduction gearing.

From Saltley the high-tension line proceeds towards Minworth to the Troutpool pumping station.

All the pumping stations are of artistic appearance, and do not in the least detract from the landscape. They were designed in the offices of the engineer to the board, as was also the generating station at Saltley. Each pumping station is divided into two rooms, one containing the pump, motor, starting gear and high-tension switch gear and the other the transformers.

The Troutpool pumping station contains one 6-in. Gwynne centrifugal pump, designed to raise 696 gallons per minute against a head

of 16 ft. It is direct-connected to a 6-hp, 960-r.p.m., three-phase motor. The starting arrangement for this motor is supported on brackets from the floor immediately adjacent to the motor, and the same plan is followed in all the other pumping stations.

The transformer chamber at Troutpool contains two 4-kw single-phase transformers having a ratio of 2,200 to 200, and is divided from the pump-room by a brick partition, the door between being kept locked, and access to it only obtained by the authorized staff of the Board; thus the risk of accident, due to ignorance or carelessness is reduced to a minimum. Similar precautions are taken at all the other stations.

In all the pumping stations the cables connecting the transformers to the switchboard are run in special trenches, covered by checkered plates and are readily accessible. The back of the switch panel projects into the transformer chamber in such a manner that the switch panel itself really forms a portion of the dividing wall between the pump room and the transformer chamber. This ensures the most efficient and shortest length of cable connections possible between the transformers and the controlling gear. All the pumping and sub-stations are arranged in a similar manner, the only difference being in the number of circuits controlled from the sub-station to meet the requirements of the particular area supplied from it.

From Troutpool the line proceeds to a pumping station at Bromford which, like the Troutpool pumping station, is equipped with a Gwynne 6-in. centrifugal pump designed to raise 696 gal. per minute against a head of 16 ft. and direct-connected to a motor of 8 hp capacity. The transformer equipment in this station is similar to that of Troutpool.

From Bromford the high-tension line proceeds to a pumping station at Ashold. This station contains one 7-in. pump designed to raise 896 gal. per minute against a head of 32 ft., and is direct-connected to a motor of 20 b.hp capacity, working at 585 r.p.m. The transformer chamber, which is designed in a similar manner to those already described, contains three single-phase transformers of 10 kw capacity each, and a switchboard built in the wall for controlling the high-tension current from the line to the transformer and then to the motor. In the case of this sub-station, however, the high-tension line is brought into the station underground, whereas in the case of the others the high-tension line is tapped immediately opposite to the sub-station, an offset being taken, and the line led into the sub-station from shackle insulators, to which are connected three highly insulated cables, which are led through the wall of the sub-station through a special type of porcelain duct. There are two low-tension circuits at Ashold, one for the pump motor, and one for the 3-hp motor which serves for driving an elevator similar to that at Tyburn.

From this station the high-tension line proceeds direct to Tyburn where the largest pumping and sub-station is situated. This station is also connected to the high-tension line by underground cable, and the transformer chamber contains three 15-kw single-phase transformers and three 7½-kw single-phase transformers, each being arranged for a ratio of 2,200 to 200 volts. The 15-kw transformers are for the power circuits, and the 7½-kw transformers for the lighting circuits. Each of the transformers is of the self-cooling, oil-immersed type.

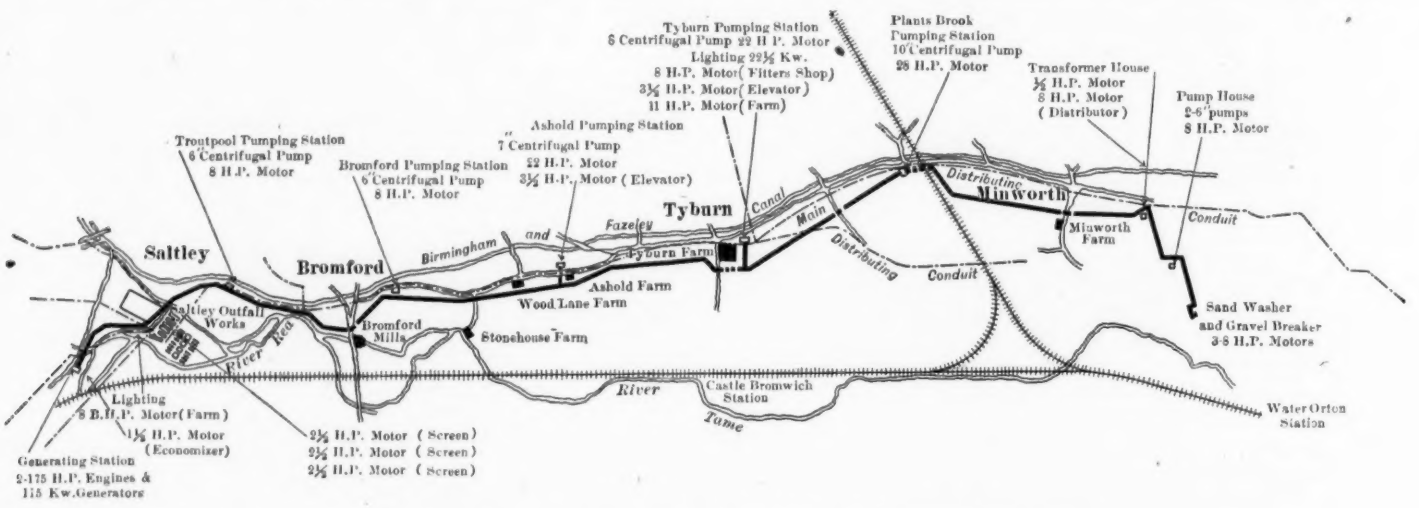


FIG. 2.—MAP OF BIRMINGHAM, TAME AND REA DISTRICT DRAINAGE.

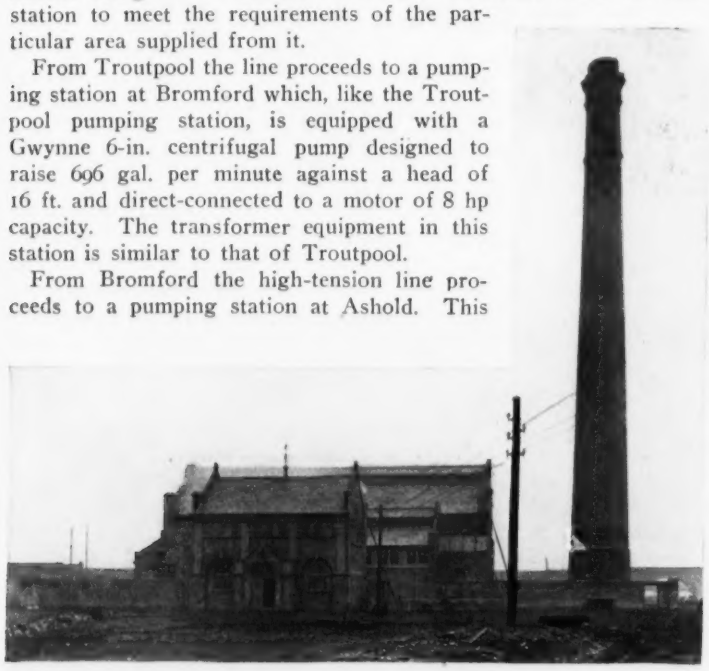


FIG. 3.—DESTRUCTOR AND MAIN GENERATING STATION AT SALTLEY.

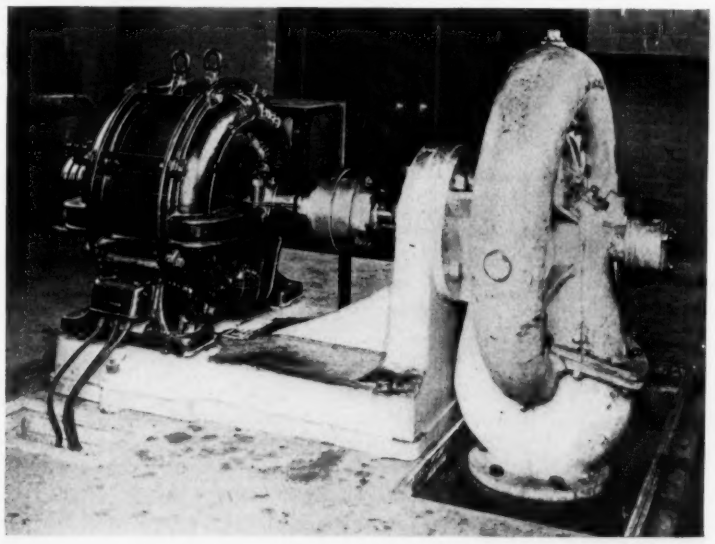


FIG. 4.—PUMP DIRECT-CONNECTED TO INDUCTION MOTOR.

At Tyburn the three power circuits are as follows:

Circuit No. 1.—This controls one motor of 8 hp running at 960 r.p.m. and one 10-hp motor running at 960 r.p.m. These motors are used for the operation of general farm machinery and for driving the mechanics shop where the mechanical repairs required to the existing plant on the Board's estate are carried out, and any special tools required on the estate are made.

Circuit No. 2.—This controls the pumping station proper, which, as in the case of the other stations, is immediately adjacent to the transformer chamber and contained in the same building. This station contains two Gwynne 8-in. centrifugal pumps, each designed to raise 963 gal. per minute against a head of 30 ft. Each of these

pumps is direct-connected to a three-phase induction motor, of 20-hp running at 585 r.p.m.

Circuit No. 3.—This controls one 3-hp motor running at 1,420 r.p.m. and driving a sewage elevator. The cable supplying this motor is partly underground and partly overhead. Fig. 1 shows the general arrangement of the motor and gearing for driving the sewage elevator.

The secondaries of the lighting transformers are connected to a special switchboard from which the circuits for the offices, engineer's residence and the home farm buildings are controlled. The cables for supplying these circuits are laid underground from the sub-station to the various buildings.

The high-tension line continues from Tyburn to Plantsbrook, which has the heaviest duty of any of the pumping stations on the estate. This station is a pumping station only, and contains one Gwynne 10-in. centrifugal pump designed to raise 1,900 gal. per minute against a head of 17 ft.; it is direct-connected to a 27-hp, three-phase induction motor, running at 485 r.p.m. The transformer chamber contains three 10-kw single-phase transformers having a ratio of 2,200 to 200 and the usual controlling switchboard.

Near this station the high-tension line is led into a conduit passing under the Midland Railway and thence to Minworth Greaves, where it terminates at present. The sub-station at Minworth Greaves is used for supplying power to operate two sewage distributors, which were previously operated mechanically, and which are used for distributing sewage over circular bacteria beds. This sub-station contains three transformers having a ratio of 2,200 to 200 volts and the necessary switchboard.

It is proposed to extend the high-tension line from this point one-half mile further towards Curdworth, where the Drainage Board is carrying out very extensive works in the building of bacteria

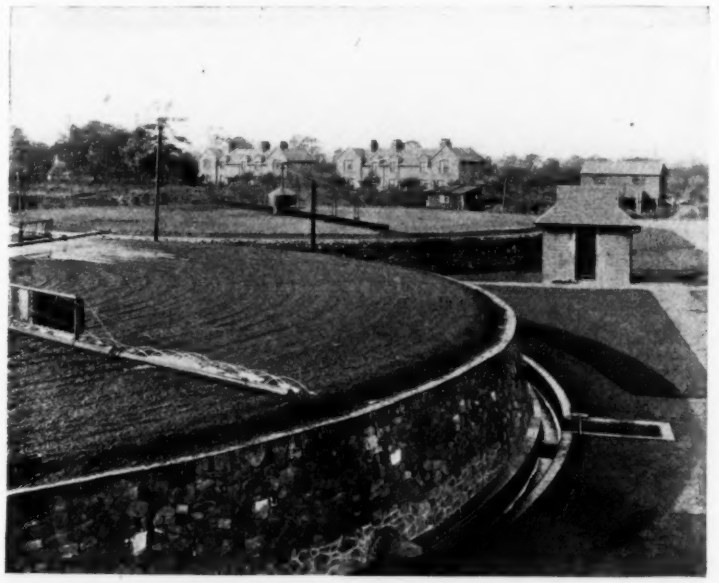


FIG. 5.—ELECTRICALLY OPERATED SEWAGE DISTRIBUTORS AT MINWORTH.

beds, and where it is intended to electrically operate the gravel-washing machinery, which in this case consists of a pump, stone crusher and winch.

It is also intended to extend the use of the electric power thus obtained by installing deep-well pumps 400 yd. from the Minworth Greaves terminus. These pumps will be supplied with current at a pressure of 200 volts direct from the same sub-station as the gravel washer.

The undertaking of the Birmingham, Tame & Rea Drainage Board, embodying as it does all the features of a comprehensive high-tension power-distribution scheme, is one of the pioneer undertakings of its kind in Great Britain, and, in so far as the application of electricity to sewage disposal in the manner described is concerned, it is the first scheme of its kind in the world. Developments arising as a direct outcome of the undertaking will undoubtedly be watched with considerable interest by all those interested in the application of electrical power to the complex problem of sewage disposal, and other industrial purposes.

The inception of this sewage scheme is due to the initiative and enterprise of the engineer of the District Drainage Board, Mr. John D. Watson, C.E.

Commutation Theory.

BY A. PRESS.

TWO of the most important considerations in the design of direct-current machinery are sparking and heating. It is the sparking that usually makes itself inopportunely manifest, and for this reason some actual working rules for ascertaining the behavior of machines in this respect should prove of service.

In the accompanying illustration, let the coil $E\,F$ be undergoing commutation, and further, let the following notation be used:

T = time of commutation.
I = current per circuit.
R = resistance of brush for the current $2I$ per brush.
t = element of time, T.
L = coefficient of self-induction of coil.

If the brush, G, which has the same width as the commutator segment, is traveling in the direction of the arrow, it is obvious that the contact resistance at the segment A will be given for any instant after the beginning of contact at the edge of B, by $\frac{R\,T}{T-t}$, and, likewise, the contact resistance at B will be $\frac{R\,T}{t}$. In deriving an expression indicating the course of the phenomena of commutation it is as well to bring in as many of the elements as possible governing the actual case. Not alone is it necessary to observe that

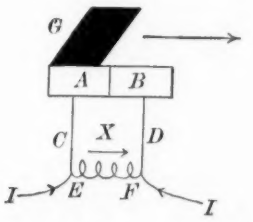


DIAGRAM SHOWING DISTRIBUTION OF CURRENTS.

at the instant when the brush leaves the segment there will be an inductive potential due to the rate of change of current in the coil $E\,F$, but that there will also be an e.m.f. generated on account of the motion of the limbs of the coil through the actual field of flux. This flux can be set up by the inductors carrying current—the commutator coil cutting the lines of force due to the remaining conductors. The current set up by this cutting of lines will be assumed as superimposed upon the current variation in the coil $E\,F$ and due to the brush passing from A to B.

Let the resistance in the leads C and D be represented by r, and let the resistance of the coil $E\,F$ proper be designated as w. Obviously, the current at any instant, in the lead C will be $I - x$, and in D will be $I + x$, where x is the current in the coil itself. The drops, then, are as follows, referring to the diagram:

$$\text{Contact resistance at } A = \frac{(I-x)}{T-t}\,T\,R.$$

$$\text{Contact resistance at } B = \frac{(I+x)}{t}\,T\,R.$$

$$\text{Lead resistance, } \quad C = (I-x)\,r.$$

$$\text{Lead resistance, } \quad D = (I+x)\,r.$$

$$\text{In the coil, } \quad E\,F = L\,\frac{d\,x}{d\,t} + x\,w.$$

Now, assuming that there is no cross field of flux (this latter will be taken as superimposable), by Kirchhoff's law the sum of the voltages in any circuit must be zero. Then

$$\frac{(I-x)}{T-t}\,T\,R + \frac{(I+x)}{t}\,T\,R + 2I\,r + x\,w + L\,\frac{d\,x}{d\,t} = 0.$$

Consider now the conditions approached as the time, t, approaches the time of commutation, T. When $t = \frac{1}{2}\,T$, the value of x will be about 0 and $A = 2I\,R$. With $t = .9T$, the value of x will be of the

order of $.9I$ and thus $\frac{.1\ IR}{.1} = IR$. Thus when $t = T$ and $x = I$, the value of A approaches to $-\left(\frac{dx}{dt}\right) TR$, and, therefore, the differential at equation can be evaluated without the very difficult process of integration. When $t = T$ and $x = J$, concurrently the equation becomes

$$-\left(\frac{dx}{dt}\right) TR + 2IR + 2Ir + Iw + L\left(\frac{dx}{dt}\right) = 0,$$

or

$$\frac{dx}{dt} = \frac{2IR + 2Ir + Iw}{RT - L}.$$

It is to be observed that the current density at the last instant is the cause of all the trouble. Should this density approach extraordinary magnitude, sparking must surely occur. Assuming the area of brush to be represented by a, the instantaneous area at A will be $a\frac{(T-t)}{T}$, and, since the current is $I - x$ the momentary density will be $\frac{I-x}{T-t} \cdot \frac{T}{a}$. However, in the limit when $t = T$ and $x = I$, if i_a is the current density at this last moment,

$$i_a = \frac{I-x}{T-t}\frac{T}{a} = \frac{T}{a}\left(\frac{dx}{dt}\right)$$

The value of $\frac{dx}{dt}$ is exactly the value derived above, and, therefore, by simple substitutions one has

$$i_a = \frac{T}{a} \cdot \frac{2IR + 2Ir + Iw}{RT - L},$$

which can again be written

$$i_a = \frac{2I}{a}\left[\frac{R + r + \frac{w}{2}}{R\left(1 - \frac{L}{RT}\right)}\right]$$

Now, $\frac{w}{2}$ is the resistance of one-half of the coil proper and therefore $\frac{w}{2} + r$ is the resistance of one-half of the coil, counting leads and all. Let this latter be represented by W. Furthermore, let $\frac{2I}{a} = I_a$, which is the normal current density in the brush, counting all the current passing through the brush and the entire area of the brush Therefore,

$$i_a = \frac{I_a\left[1 + \frac{W}{2R}\right]}{1 - \frac{L}{RT}}.$$

From this equation is obtained a working rule: Firstly, that $\frac{L}{RT}$ shall at least be less than unity, and, secondly, that the resistance of the commutated coil leads and all shall be as small as possible.

The expression $\frac{W}{2R}$ can be written $\frac{IW}{2IR}$, in which IW is the ohmic drop in the coil (which is actually spanned by the leaving tip of brush at the last moment), and $2IR$ is the drop from brush to commutator with the whole current per brush.

To complete the conception of commutation phenomena, it will be necessary to allow for the voltage generated in the coil (with no shifting of brushes). It is this entire voltage that has to be corrected for by so adjusting the position of the brushes that at the last moment the current density is almost normal. Let the generated voltage be e. The resistance of the brush will have the same value as formerly, i. e., R. The resistance of contact at A is now $\frac{RT}{T-t}$, and at B it is $\frac{RT}{t}$. The total resistance of the circuit is, therefore,

$$\frac{RT}{T-t} + \frac{RT}{t} + W = \frac{RT^2}{t(T-t)} + W.$$

The current, y, set up will be due to the voltage, e, and the self-inductive relation will be later added. Thus,

$$y = \frac{e}{\frac{RT^2}{t(T-t)} + W},$$

and when $t = T$,

$$\frac{dy}{dt} = \frac{d}{dt}\left[\frac{etT - eT^2}{RT^2 + 2Wt(T-t)}\right] = -\frac{e}{RT}.$$

Now, if $y = f(x)$ and $y' = \phi(x)$, and $Y = y + y' = f(x) + \phi(x)$, and $\frac{dY}{dt} = f'(x) + \phi'(x)$, and thus the differentials add.

Hence, instead of $\frac{dx}{dt}$, which was used exclusively above, it is necessary now to take

$$\frac{dx'}{dt} = \frac{dx}{dt} + \frac{dy}{dt} = \frac{2IR + 2Ir + IW}{RT - L} + \frac{e}{RT}.$$

However, the current set up at the last moment, due to e, is

$$dy = -\left(\frac{e}{RT}\right) dt.$$

The area available is $a\frac{(T-t)}{T} = a\frac{dt}{T}$.

Let the extra current density be represented by $i'a$. Then

$$i'a = \frac{1}{a}\left(\frac{dy}{dt}\right) T = \frac{T}{a}\left(\frac{dy}{dt}\right) = \frac{e}{aR}$$

by substitution. Adding the current densities at the last moment one has

$$i''a = i_a + i'a = \frac{2I}{a}\left[\frac{1 + \frac{W}{2R}}{1 - \frac{L}{RT}}\right] + \frac{2I}{a} \cdot \frac{e}{2IR}.$$

Let the drop $2IR$ across the brush contact area be represented by V, then

$$i''a = I_a\left[\frac{1 + \frac{IW}{V}}{1 - \frac{L}{RT}} + \frac{e}{V}\right]$$

One should, therefore, also endeavor to cut down the voltage due to armature reaction as well. The factor included in the brackets will indicate how much lag or lead must be given. This cannot

be increased beyond a certain amount (dependent upon the type of pole shoes) before sparking will be increased, because the self-induction is increased by proximity to the pole shoes. The expression just evolved is a measure of the current density that would be produced at the last instant provided the brushes had been left in the no-load neutral position. If the self-induction be assumed of a value such as to make $\frac{L}{RT}$ negligibly small compared to unity, the factor for the current at the last moment reduces to $1 + \frac{IW + e}{V}$, and the whole expression is one which may be used as a criterion of sparking. In any event, it will serve to show the direction in which commutation can be improved. In practice it is found that commutation is made worse in about direct proportion to the number of bars covered. Furthermore, in wave-wound armatures a factor of safety should be introduced that would make this last factor at least one-half the number of poles times worse than what it would be for lap-wound armatures.

A New Type of Frequency Meter.

By A. S. LANGSDORF.

UNDER the above title the author presented a paper at the convention of the American Association for the Advancement of Science held in December, 1903, but the paper was not published except by title.* In June, 1904, the device originally described by the writer was independently conceived by Mr. J. F. Begole of the Wagner Electric Mfg. Co., and it has recently been placed on the market.

The principle involved in this instrument is based upon the fact that if an alternating (sinusoidal) electromotive force of E volts and frequency, f, is impressed upon a condenser of capacity C farads the current may be expressed in amperes as,

$$2\pi f E C.$$

In other words, for a given value of C, the indications of an ammeter will be proportional to the frequency, *provided* E remains constant, in which case the scale of the ammeter could be graduated to read directly in cycles.

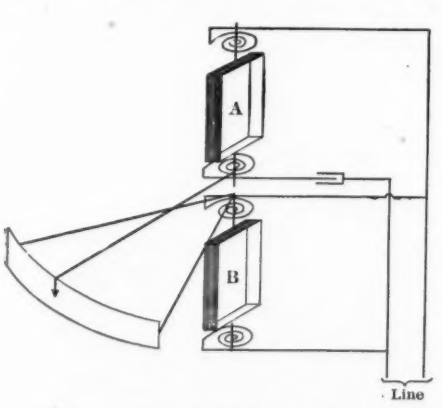


FIG. 1.—CIRCUITS OF FREQUENCY METER.

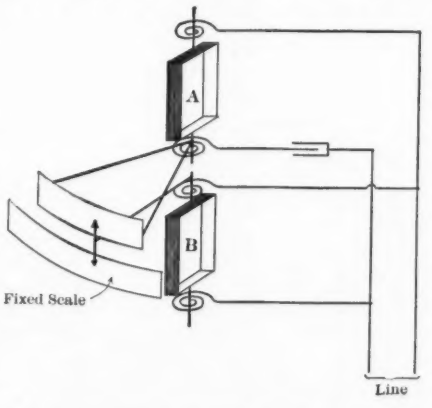


FIG. 2.—CIRCUITS OF COMBINED FREQUENCY METER AND VOLTMETER.

It is, of course, evident that the assumption of constant electromotive force is not justifiable where commercial circuits are concerned. If the scale of the ammeter mentioned above were graduated to read cycles, a change in line voltage would be recorded as an apparent change in frequency. This difficulty can be overcome, however, if the scale of the ammeter is itself movable, and is pivoted on a line coaxial with that of the pointer or indicator of the ammeter; if the motion of the scale, due to a change of voltage, is made equal to, and in the same direction as, that of the ammeter needle, there will be no relative motion between the two, and the reading will remain unaltered.

To secure this compensating scale motion, the scale need only be attached to a bobbin which is constructed in all respects like that of an ordinary voltmeter, this voltmeter winding being then connected across the line.

The mechanical construction and electrical connections of the instrument will be easily understood by an inspection of the diagram, Fig. 1. A is a bobbin to which the pointer is fastened, and which carries the condenser current. Directly below (or above) it is mounted the bobbin, B, which carries the graduated scale.

As the instrument is actually constructed, advantage is taken of the fact that the presence of bobbin, B, permits of voltage indications also; this latter idea is due to Mr. Begole. Fig. 2 is a diagram of the combined voltmeter and frequency indicator. The scale and pointer of Fig. 1 are here interchanged, A now carrying the movable scale and B the pointer; an extension of the latter, moving over a fixed scale, indicates volts.

* *Proc.* Amer. Assn. Adv. Science, Vol. LIII. (1904), p. 380.

A Short Single-Phase Railway on Long Island.

AN urban railway system which has recently been installed by the Long Island Railroad Company at Glen Cove, L. I., possesses many points of more than passing interest when considered in connection with present developments in the electric railway field. The railway is intended to convey passengers from Sea Cliff and Glen Cove stations on the Long Island Railroad to the neighboring steamboat landings on Long Island Sound.

The principal interest in the railway system resides not in the magnitude of the undertaking, since the total length of track now completed and under construction is only about five miles, but in the means employed for supplying power to the rolling stock. The present system had its beginning in a small direct-current railway which was owned by the Long Island Railroad Company, which purchased the necessary power for operation from a local electric company. When the Long Island Railroad Company established a generating station at Long Island City it was ascertained that power could be transmitted from this station over the intervening distance of about 27 miles, and there used by single-phase motors more advantageously than it could be purchased and used by direct-current motors.

The power is transmitted directly at the station pressure of 11,000 volts over two No. 1 bare copper wires placed on a wooden pole line extending from the Belmont Park sub-station of the Long Island electric railway system to a transforming sub-station located adjacent to the passenger station of the Long Island Railroad at Glen Cove. The transforming sub-station equipment consists of two 200-kw, oil-cooled, 11,000-volt to 2,200-volt, 25-cycle transformers, and the necessary switching and protecting devices. The high-potential lines enter through the center of double-glass windows and, passing through spiral choke coils, terminate in oil switches which are connected in the primary circuit of the transformers. The oil switches are enclosed in separate cement compartments and are operated by a system of levers, the handle for which is placed on a separate panel adjacent to the 2,200-volt switchboard. The 11,000-volt circuits are in no wise connected to the switchboard, and the 2,200-volt circuits are represented in the front of the board only after having passed through current and potential transformers. A bank of low-equivalent lightning arresters serves to protect each line entering the building.

No attendants are required at the sub-station. In the event of the primary switches being opened from any cause, an electric bell in the adjacent passenger station notifies the agent, who can conveniently close the switch. Although only one of the phases of the three-phase generating system at present supplies power to the railway, the sub-station equipment is designed for three-phase operation. All switches, lightning arresters and switchboards are of the three-phase type, two-thirds of the equipment being used at present. With future extensions, a third transmission wire will be erected and a third transformer will be installed, so that power can be obtained from all three of the phases.

A view of the interior of the sub-station is given in Fig. 3, which shows the switchboard panels for the 11,000-volt and the 2,200-volt circuits, and the high-potential lightning arresters and indicates the location of the choke coils and oil switches. The overload release device is operated by current from the low-potential circuit, but it is arranged to open the oil switches in the primary circuits of the transformers. The handle for the lever which controls these switches is placed at the center of the right-hand panel, and the trip

which causes the lever to operate is moved by an electromagnet located immediately below the handle. The mechanical connection between the levers and the corresponding switches is made by means of iron pipes which are arranged beneath the concrete flooring of the second story of the sub-station building. The lower story of the building contains the transformers, and it serves also as an office for the operating and constructing forces of the railway company. A complete record is kept of the energy used by the railway during each day, a watt-hour meter being used for this purpose. Tests have shown that the original expectations as to the economy of operating

FIG. 1.—VIEW OF SINGLE-PHASE CAR, GLEN COVE RAILWAY.

with alternating current transmitted from Long Island City rather than with direct current purchased locally have been fully realized.

At the present time four cars have been equipped. Two of these cars are of the single-truck type, and each weighs 14 tons, while each of the other cars is supplied with double trucks and weighs 17 tons. The single-truck cars are of the semi-convertible type, were supplied by the J. G. Brill Company and are mounted on that company's No. 21-E truck. One of the double-truck cars is also of the semi-convertible type, similar to the ones just described, while the other is of the open type.

The driving equipment of each car consists of two 50-hp Westinghouse single-phase, conductively-compensated series motors, operated permanently in parallel and subjected to potential control. Each motor is a four-pole machine, designed for 25-cycle current at an effective potential of 300 volts. Each armature is provided with a lap-connected winding, taps being taken from the end of each coil to the corresponding commutator segment through a certain resistance lead which is placed in the bottom of an armature slot. The motor is supplied with four brush studs, there being two brushes per stud. Each brush is ⅜ in. in width and covers approximately 1.5 commutator segments. Inspection shows that very little sparking is produced even under the severest starting conditions, and that the arcing is not destructive in nature. The application of a thin coating of vaseline about once each week represents the extent of the attention required by the commutator. The four brush studs are mounted on an annular ring, which is arranged to be rotated through 360° when desirable, so that all brushes can be inspected from the top opening in the frame of the motor. The brush studs are connected in two pairs to two copper bus rings which are joined to flexible leads, which pass through the frame by way of substantial insulating bushings, after the compensating stator winding has been included in the armature circuit. All of the bearings of the motor are provided with boxes in which waste is placed, and lubrication is obtained by the use of heavy machine oil.

As stated previously, the variation of the speed of the motor is obtained by subjecting the motor circuits to different voltages. For this purpose there is provided on each car a variable-ratio transformer having a single coil, which acts simultaneously as a primary and a secondary. This so-called auto-transformer is connected directly across between the trolley and the rail circuits, and voltages of different values are obtained by connecting the receiver apparatus between the rail circuit and intermediate taps on the transformer winding. Six of the intermediate taps, giving effective e.m.f's of 160 volts, 190 volts, 220 volts, 250 volts, 288 volts and 310 volts, respectively, are devoted to the use of the propelling motors. There are on the controller, however, only five running points, corresponding to voltages 175, 205, 235, 265 and 295, respectively. It will be observed that the e.m.f. impressed upon the motor circuits is in each case intermediate between the voltages available at the transformer taps. This intermediate voltage is obtained through the use of so-called preventive resistance and preventive reactance, the prime object of which is to eliminate sparking at the controller. The motor circuits receive current from the middle points of the preventive reactance coil and the preventive resistance. When the controller is on any one of the first four accelerating points, both the coil and the resistance are submitted to an e.m.f. of 30 volts. This voltage forces a certain current through the preventive resistance independent of the operation of the motors, and it causes a certain exciting current to flow through the preventive coil. In addition to its exciting current, there flows through each half of the preventive coil one-half of the current to the motor circuits, the two components of the motor current flowing in opposite directions in the two sections of the coil. In changing the controller from a running position to the one next higher in voltage, the lower e.m.f. terminals of the preventive coil and resistance are disconnected from the corresponding tap on the auto-transformer and transferred to another tap 60 volts higher in e.m.f. At the intermediate position of the controller only the necessary exciting current flows through the preventive coil, while one-half of the preventive resistance carries the whole of the current to the motor circuit. It is evident, therefore, that the windings on the transformer are never short-circuited and the circuit to the motors is never opened during the accelerating period. When the controller is placed on the running position giving the highest voltage, the preventive resistance is excluded from the circuit and only the preventive coil is in use, thus eliminating that loss in the preventive resistance due to the 30 volts across its terminals, which is found at the four other running points of lower voltage. Experience shows that there is no perceptible arcing at the contacts when the controller is changed from one

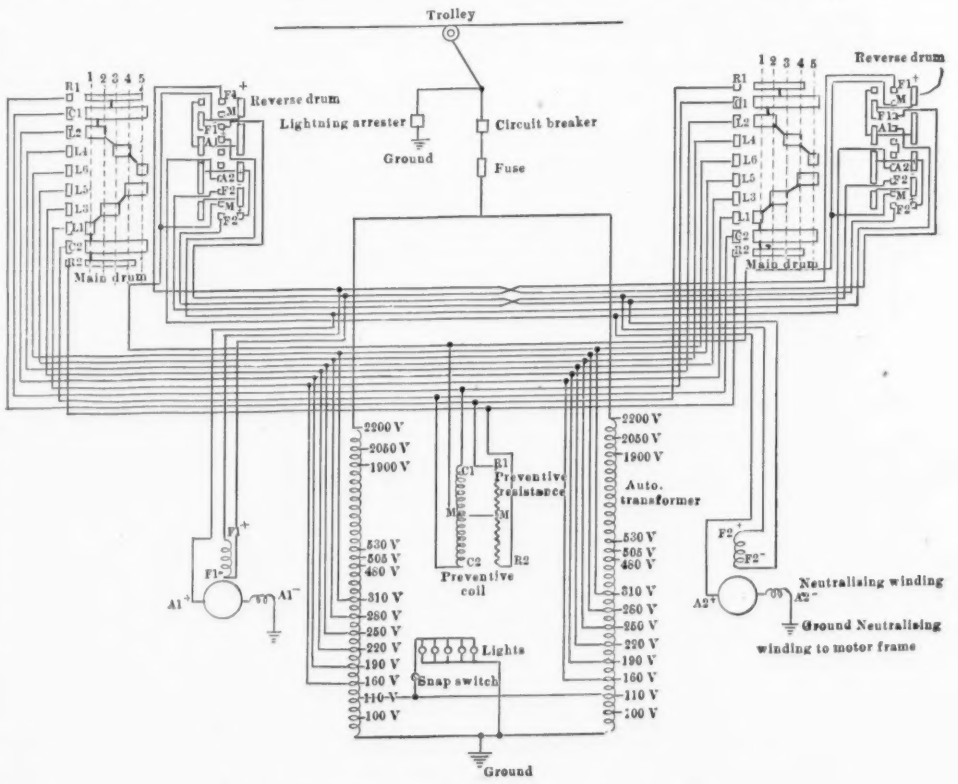


FIG. 2.—DIAGRAM OF CONTROLLER CIRCUITS.

running position to another, and that when the controller is thrown to the "off" position the arcing is very slight. Mechanically, the preventive resistance is built up of cast-iron grids similar to those used in direct-current street car rheostats, and is suspended from the supporting beams of the car body. The preventive coil is an air-cooled, 30-volt auto-transformer, and is similarly disposed.

The main auto-transformer of each of the double-truck cars is rated at 50 kw, and is of the air-cooled type. Special pains have been taken to eliminate all unnecessary weight of this transformer and to render it as compact as possible. Although each single-truck car is provided with two 25-kw auto-transformers, they are electrically so interconnected as to form virtually a single 50-kw transformer. The object in thus dividing the transformer was to allow of a proper distribution of the weight, since sufficient space was not available for placing it under the center of the car, and it was not considered advisable to concentrate the weight at one end. The division of the transformer into two parts also permits of cooling each part more effectively than would be true with a single transformer, since the superficial area of the two smaller transformers is much greater than that of the single transformer. It is worthy of note in this connection that even on the small 14-ton cars no trouble whatsoever has been encountered in finding abundant room for all of the equipment, and there is little about the car itself to suggest to the casual observer that the equipment is other than that usually found on direct-current railways.

The lamps of the car, including those for the two headlights, are connected in parallel and receive current from the 110-volt tap of the main auto-transformer. From the same tap is taken current for operating the rheostatic heaters of the car.

Each car is provided with a plain mechanical hand brake. Although no air-brake equipment is supplied, and the controller has not been designed especially for electric braking, it is worthy of note that there is available an emergency braking arrangement in event of the simultaneous failure of the hand brakes and the interruption of the supply of power. When the controller is in any running position the two motors are joined directly in parallel. It is found that if, when the car is traveling in a certain direction, the reverse lever be thrown over and the controller handle be placed in any running position, the motors will act as opposed direct-current series generators and rapidly limit the speed of the car, in the manner well known with direct-current equipments.

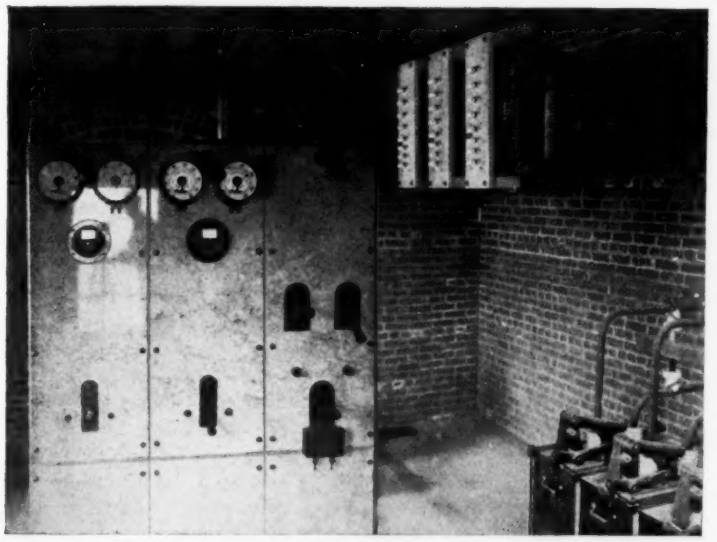


FIG. 3.—INTERIOR VIEW OF SUB-STATION.

The most prominent feature of the high-potential circuits of the car resides in the extreme simplicity. The trolley pole differs in no wise from the standard construction used in street car work, and it is provided with the usual grooved wheel. The socket in which the base of the pole is placed is rigidly attached to a special platform which is mounted on four substantial porcelain insulators immediately over the center of the car. The conducting circuit from the pole passes across a Wurts lightning arrester equipment suspended beneath the special platform, and is then led through grounded protecting tubing to an oil circuit-breaker and switch placed in the canopy of the vestibule. All metallic parts of the car are thoroughly grounded, even the lower end of the trolley rope being joined to the framework. Two wooden strain insulators are inserted in the trolley rope for the purpose of preventing the passage of leakage current when the rope is damp.

The overhead trolley work throughout is of an exceedingly substantial nature. The conducting wire has an area equivalent to a B. & S. No. 3-0. It is of a specially grooved section, and is held in place by means of clamping ears which are suspended from a 7/16-in. steel cable catenary. The method of supporting the catenary varies with the curvature of the track and the nature of the locality. Since very little of the road length is laid on tangents and the route covers village streets, country roads and steam road beds, almost all types of suspensions are in use. Along the track which is laid on the bed of the steam road, that is, for a distance of one-half mile between Sea Cliff and Glen Cove stations, and along a portion of the country roads, the catenary is held in place by means of a bracket arm construction employing wooden poles spaced 120 ft. apart. Along the route of the old direct-current railway, the original side brackets were used without alteration. Each bracket arm is an iron pipe 2 in. in diameter, which serves to hold the trolley wire about 21 ft. above the rails. Along the line adjacent to the steam road the brackets are made of substantial T-irons. Within the towns the catenary is held in place by means of side-pole and double span-wire construction. In the town of Glen Cove the side poles are built up of iron piping of three sizes, having diameters of 6 in., 7 in. and 8 in., respectively. Each pole is 30 ft. in length and is set 6 ft. in the ground on a bed of concrete, the hole being filled with concrete to the level of the ground. The span wires, which are made of 7/16-in. steel cable, are supported and insulated from the iron poles by means of substantial porcelain sleeves. Each sleeve is cemented around a short length of iron piping, the two ends of which are secured to the iron pole by clamps and retaining bolts. The span wires are fastened to a malleable-iron collar, which surrounds the porcelain sleeve, a separating lead collar serving to insure that the mechanical pressure of the iron collar is properly distributed over the porcelain sleeve. In all cases the major insulation of the line is provided by these porcelain sleeves. The catenary is connected directly to a center porcelain sleeve insulator which is supported from the lower of two span wires. This lower span wire is itself supported from the upper span wire, and in it are inserted two hickory strain insulators, one on each side of the center porcelain sleeve. Owing to the fact that the trolley collector is of the wheel type, guard loops are provided for those porcelain sleeves from which the catenary is directly suspended, in order to protect the insulator in event of the trolley wheel leaving the wire.

Over certain sections of the railway, where electric light and telephone wires are numerous, guard wires have been erected in order to prevent fallen wires from coming in contact with the catenary or the trolley wire. For this purpose 30 in. above the central trolley wire and catenary have been placed two galvanized-iron wires, which are separated from each other by 18 in. These guard wires are thoroughly insulated from, and supported by, a system of span wires, which are grounded to the side poles. The two wires are transposed at frequent intervals, and it is expected that they can be utilized as a telephone circuit in spite of their proximity to the trolley wire carrying alternating current.

In the town of Glen Cove the street over which the cars operate is paved with brick. Throughout this section of the railway the track is formed of 130-lb. girder rails, electrically-connected through protected ribbon bonds. The terminals of these bonds are placed in holes freshly drilled in the rails, and excellent and continued conductivity is assured by the use of a wedge-shaped steel core which is driven in a hole in the terminal, and forces the copper of the terminal into intimate contact with the unoxidized surface of the iron web. This bond is then covered by the fish plate. The track, which is laid parallel to the steam road and on the same roadbed, is formed of 70-lb. T-rails, which were previously used on the steam road. These rails are interconnected by means of protected ribbon bonds, similar to those used on the girder rails.

This road has been in service for the past two months with thoroughly satisfactory results. While the original rolling stock is now idle, and the cars at present in use are throughout of new construction, it is the intention to substitute alternating-current motors for the direct-current machines on the older cars, and to place all cars in service during the next summer season.

Acknowledgments are due for courtesies extended in the preparation of this article to Mr. L. S. Wells, electrical superintendent of the Long Island Railroad; to Mr. George Gibbs, chief engineer of the Pennsylvania, New York & Long Island Railroad; to Mr. R. G. Slack, of the Long Island Railroad, and to Mr. H. T. Gibbs, of the Westinghouse Electric & Manufacturing Company. The work was carried out under the direct supervision of Mr. Wells, and the equipment of the road with the single-phase system was due largely to his advocacy of it.

Some Obstacles to Electrical Development in Great Britain.

BY W. VALENTINE BALL, M.A., *Cantab. Barrister-at-Law.*

PEOPLE in the United States sometimes wonder why the old country is so much behind hand in matters electrical. At least they wonder why the statement is so often made that, in spite of its having given the lead in these matters England no longer takes a foremost place among the countries where electricity is used for light and power.

It is unnecessary for the present purpose to make any admission as to the truth of the above statement. Indeed, it would be the task of an expert electrician to decide which of any two countries was ahead—leader of the electrical world. Many circumstances would have to be considered; many causes, wholly beyond the control of the government or the legislature of a country might tend to retard its progress in this respect. A single illustration suffices. In a country where there is abundant water power, the ingenuity of the inhabitants will be directed toward transmitting that power from the mountain torrent to the manufacturing center. Naturally electricity is the chosen medium, and in the result an impetus is given to electrical development which is not experienced in a country where coal is abundant, and the necessity for transmitting power over long distances is not so apparent.

The absence of water power is a difficulty which it is beyond the power of man to overcome. If the natural advantages of one country outweigh those of another in one respect there is sure to be some compensating advantages somewhere else.

Other influences may, however, be at work to stem the tide of electrical progression. It is with these influences which have been at work in England ever since electricity became a power in the world, that we propose to deal in the present article.

To indicate to the American reader exactly how electrical progress in England is checked by governmental and other interference it will be necessary to explain, as shortly as possible, the manner in which power to supply electricity (whether for lighting or power purposes) must be acquired.

Let us first take electric light. If a company is formed for the purpose of generating electricity to furnish a town or district it is practically necessary to obtain the sanction of Parliament. It is true that in England there is no reason why a private person or company should not supply electricity to his neighbors upon whatever terms he chooses; but in order to obtain leave to break up streets for the purpose of laying down mains and cables it is necessary to obtain the sanction of Parliament.

It is obvious that unless a supply company is allowed to carry its mains over or under the streets of a town, the scope of its operation must be very much restricted. What, then, is the procedure to be adopted in order to obtain the sanction of Parliament? Two acts were passed, in 1882 and 1888, respectively, which laid down certain general rules and conditions on which a "provisional order" for the supply of electricity may be granted. A provisional order is an order made by the Board of Trade which specifies the conditions under which the supply of electricity is to be given to the public; the notices which are to be given to those whose property may be interfered with by the uprooting of streets; the maximum prices which may be charged to the consumer, and makes provision for the regulation and testing of the motors used by consumers. The common and usual clauses in a provisional order are now to be found in the schedule to the Electric Lighting (clauses) Act, which was passed in 1899. This schedule is incorporated with every private act which regulates the supply of electricity, although in particular instances its provisions may be subject to modification.

A provisional order must be confirmed by an act of Parliament before it becomes law; but it may be mentioned that for a number of years past this confirmation has been a mere matter of form unless some clause of an unusual character made its appearance in the order. Note, however, that although it is in practice a mere form the confirmation of every provisional order by act of Parliament is essential. Let us go one step further and see how a provisional order comes before Parliament for confirmation. The usual preliminaries having been complied with, the bill comes before a parliamentary committee who consider its various clauses. The promoters of the bill call witnesses in support of its provisions, and to show that a supply of electric light in the district is needful. Opposition may take the form of an objection to the principle of the bill on the ground, say, that the supply of electricity is not necessary in the district; or else opponents may object to particular clauses. For instance, a land owner might object on the ground that it was proposed to take a portion of his land on which to build a generating station. After it has been approved by a committee the bill then goes before the houses of Parliament, and is passed into law.

The parliamentary formalities which must be gone through in order to obtain the necessary power to supply electricity are not here described for the purpose of showing that they place serious obstacles in the way of the promoter.

The chief obstacles are those which are presented by the opponents, who, then, are the opponents to measures which, even if they were promoted by persons as a speculation, are incidentally of great public importance. It is the local authorities who have shown determined opposition; it is the craze for municipal trading in England which has formed the chief obstacle to private electrical enterprise. Nay, it might almost be said that this craze has proved a hindrance to electrical enterprise of every kind, although it is true that there are numerous local bodies in the country who are using electricity in one form or other. To put it bluntly, Parliament has conceded to local authorities a right to oppose the grant of powers to private bodies, with the result that although the opposing body may not be ready to embark upon enterprise on its own account, it is able to clog the wheels of private enterprise. Let us give an illustration of the way in which this right to oppose may be exercised. The electric lighting acts decree that if a private company seeks power to supply electricity in any district, it cannot obtain a provisional order for the purpose *except with the consent of the local authority.* It is true that a government department—namely, the Board of Trade—has power to dispense with this consent; but this power of dispensation has seldom, if ever, been exercised, and in the promotion of larger schemes for the spread of electrical power the opposition of local authorities is always the most formidable difficulty in the way of the promoters. We venture to quote, in illustration of this point, a passage from the history of a scheme known as the Administrative County of London Electric Power scheme, which was frustrated.

Strange as it may appear, the English metropolis is very badly served with electricity. Owing to the fact that many of the generating stations which do exist are small, out of date, and in such positions that fuel supply is a constant and increasing source of difficulty, the prices at present charged for electric light are far too high, while even the charges for electricity for power purposes are well nigh so large as to prohibit the use of electricity for power purposes. So expensive is the supply of electricity for lighting purposes that in many districts the street authorities are having recourse to gas instead of electricity for street lamps. It should be pointed out that the present supply, such as it is, is partly in the hands of private companies and partly in the hands of the borough councils. London is divided up into a number of boroughs and the council of many a borough has power to grant the right for supplying electricity for lighting.

Until 1904 no serious attempt was made to remedy this state of things in the English metropolis. In this year, however, a bill was brought before Parliament by which it was sought to establish a power scheme for the supply of the whole of London. Put shortly, the idea was to establish two or three large generating stations on the banks of the Thames. In such a position water-borne fuel can be easily obtained, while there is an ample supply of water for condensing purposes. It was proposed to use turbo-generators of large size. In order to have due regard for the vested interests of existing supply companies and borough councils, it was suggested by the bill to supply these bodies with power "in bulk" and allow them to redistribute it to the private consumer; and it was estimated that owing to the low cost of production the central body would be able to supply power in bulk at the extremely low price of .8d. per kw-hour and yet make a profit! Seeing that this bill would be of enormous advantages to manufacturers it was received with acclamation by all who wanted a supply of electricity on a large scale for power purposes; and it may be prophesied that, had it not been for the opposition which was experienced from local authorities, the promoters would have been successful in their venture. What was the nature of this opposition? It came, in the first place, from many of the borough councils, who feared that the ultimate effect of the

bill would be to oust them from their respective positions as electric supply authorities; and in the second place opposition came from the London County Council, which body, although they had no similar scheme of their own on the *tapis*, appeared to consider that the door should be kept open for them in the future. The bill was considered and ultimately approved by a committee of the House of Lords and a committee of the House of Commons, but owing to the bitter nature of the opposition the session of Parliament for 1904 was rapidly drawing to a close when the bill had passed through committee. Owing to pressure of other business the House of Commons was unable to consider the bill before August 12, with the result that it had to be dropped. If the promoters desire to repeat their attempt they must needs go over the same ground in the next session of Parliament. When it is mentioned that the cost of promotion in 1904 came to something like $250,000, the true meaning of opposition on the part of local authorities is brought into relief. Such is English parliamentary procedure that all this expense will have to be incurred in another session if the promoters are desirous of carrying out their undertaking. But as a matter of fact, what has happened in the meantime? The London County Council, who led the van of those who opposed the promoters, are now proposing to put forward a bill on their own account under which they will seek to supply power to the whole of London. This bill is to come up for consideration in 1906, and it is quite possible that Parliament, as then constituted, will lend a more favorable ear to the County Council than to those who were the founders and originators of the whole scheme.

What has been done on a large scale in the above case is continually occurring on a small scale in relation to the supply of electricity whether for lighting or power purposes. The development of electric tramway systems has been subjected to the same hindrances. Let us now draw attention to some of the advantages which a local authority supplying electricity enjoys, advantages which are by no means extended to private electrical undertakings. We have seen that a local authority may veto the grant of power to supply electricity to any company in its district; it may exercise this power whether it is or is not in a position to supply electricity itself. By so doing it may keep down opposition and preserve a virtual monopoly for itself.

Then again, suppose a private person or firm starts to supply his neighbors with electric light. The local authority, which in England as a general rule has control over the highways, may draw a circle around his area of supply by prohibiting him laying mains under or over the road. Further, in granting a supply on their own account, a local authority enjoys an immunity and a license which is not extended to ordinary companies. Thus an action brought against a supply company for negligence must be commenced within a certain time or it may not be commenced at all; and if the plaintiff loses his case he has to pay the defendant's costs on a scale which is much higher than that usually applicable. It may, however, be stated here, for the benefit of American readers, that in England as a general rule, the unsuccessful party has to pay the successful party's costs. In ordinary cases they are a sufficient burden for the disappointed litigant; but when a local authority has been successful a very serious burden is imposed upon the unsuccessful party.

Having enumerated the disabilities under which private companies supply electricity in England, it may be asked why is no redress sought? The answer is that it has been sought without avail. Time and again bills have been introduced into Parliament for the purpose of removing that embargo which under existing conditions local authorities are enabled to put upon electrical enterprise. For some reason or other this bill has never been successful. It is hoped, however, that in some future session the question may have the earnest attention of the legislature.

Electric Lift for Swiss Mountain.

An electric lift is being constructed to give easy access to the summit of Mont Hammetschwand, in Switzerland. It is 518 ft. high. Motive power is supplied by a 15-hp shunt-wound motor with Gramme armature, running at 900 r.p.m. at 1,200 volts. All operations of starting and stopping are performed at the bottom of the lift. The greater part of the lift is girder construction, anchored at intervals to the vertical side of the mountain.

Reflectors, Shades and Globes.—IV.

BY J. R. CRAVATH AND V. R. LANSINGH.

HAVING shown tests on a large number of miscellaneous reflectors in previous chapters we come now to the prismatic glass types of reflectors, in which the reflection is accomplished by means of prisms pressed in the glass. The popularity of this class of reflectors lies in the fact that they can be designed so as to give almost any kind of a downward distribution of light desired, while at the same time enough light passes through the glass without reflection so that the ceilings and upper walls of a room are not left in darkness. Some of these reflectors are designed to be very powerful concentrators of light, while others distribute the light over a wide angle below the lamp, giving an even illumination over a large area. In the practical application of light, very many cases arise where it is desired to have the greater part of the light concentrated under the lamp, and yet where it is not desirable to have the reflector entirely opaque. The prisms break up the light rays so that the reflected light with these types is almost free from streaks.

Fig. 23 shows the distribution of light about a 120-watt "Meridian"

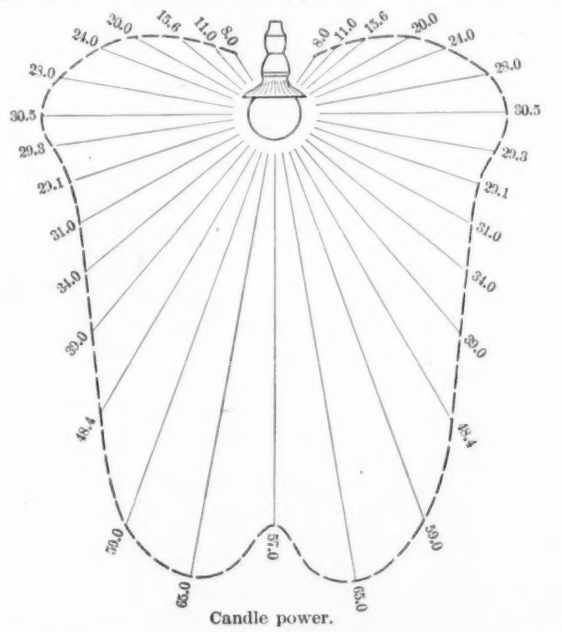


FIG. 23.—DISTRIBUTION OF LIGHT FROM "MERIDIAN" LAMP WITH "PAGODA" REFLECTOR.

incandescent lamp with a "Pagoda" prismatic reflector. This lamp, which is shown in Fig. 23A, has a large spherical frosted bulb

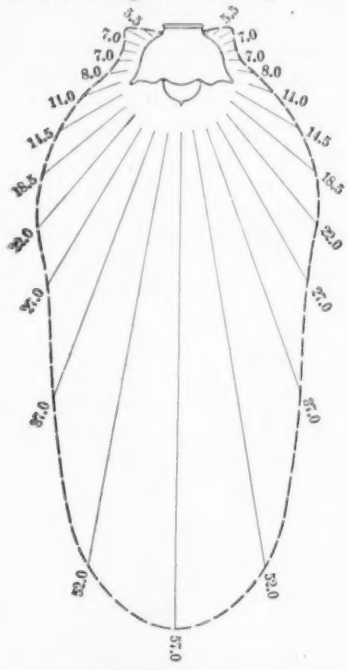
FIG. 23A.—"MERIDIAN" LAMP WITH "PAGODA" REFLECTOR.

The upper part of the bulb coming next to the reflector is not frosted. It will be seen that this gives a fairly concentrated downward light. It should not, therefore, be attempted to make this lamp cover too great an area. On account of its artistic appearance, the lamp is well adapted to use on a ceiling to be studded with a number of lights, or for the lighting of a small room with one central light at the ceiling. It is also suited for use on chandeliers where a con-

centrated light is desired below the chandelier. As a light producer this lamp is very similar to a standard frosted bulb 32-cp incandescent lamp equipped with a prismatic reflector. Its cost is somewhat higher than the standard lamp, but its appearance is by some considered enough better to justify the expense.

Another incandescent lighting unit using prismatic glass reflectors is the new high-efficiency graphitized filament incandescent lamp of the General Electric Company. These are sold with sockets fitted with substantial shade holders, the lamp socket and shade holder being sold usually as a unit. As the photometric curves showing the distribution of light around these lamps equipped with their reflectors have been extensively published in descriptive and advertising matter pertaining to these lamps, it will hardly be necessary to reproduce them here. These lamps are equipped with frosted bulbs, as they give a very powerful light, and if some means of diffusion was not provided the blinding effect due to the glare of the filament would be very great.

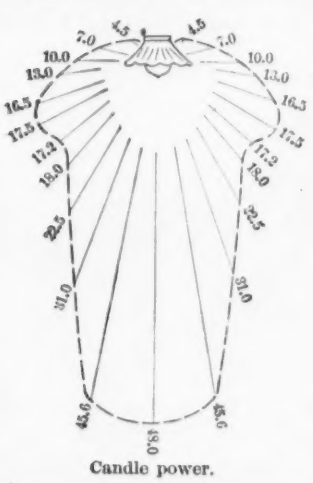
We will now take up several



FIGS. 24 AND 24A.—DISTRIBUTION OF LIGHT FROM "PAGODA" PRISMATIC REFLECTOR.

representative types of prismatic glass reflectors designed for use over standard incandescent lamps with standard shade holders. As many of the photometric tests on these reflectors are obtainable from their manufacturers upon application, it will not be necessary here to give anything further than the tests of a few representative types. Only enough tests will be given to afford the reader a good idea of what the various types accomplish and how they compare with other kinds of reflectors.

Fig. 24 shows the distribution of light about a 16-cp incandescent lamp in a "Pagoda" prismatic reflector, shown in Fig. 24A, which is in extensive use, and concentrates a large amount of light below the lamp. The maximum candle-power for an angle of a few degrees is as high as 57, while it gives more than would the bare incandescent lamp at all angles below 30° from



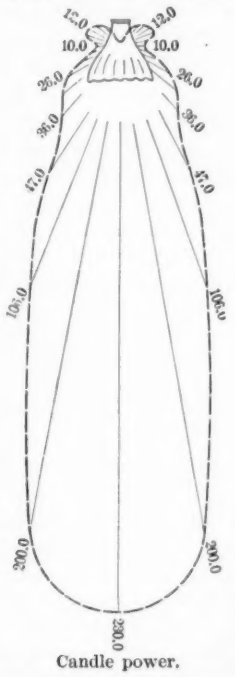
FIGS. 25 AND 25A.—DISTRIBUTION OF LIGHT FROM "PAGODA" PRISMATIC REFLECTOR.

the horizontal. This reflector is suited to all locations where a concentrated light is desired at one point, without distribution over a wide area. This includes desk lights and reading lights on downwardly pointed pockets on chandeliers. It would be a mistake to attempt the general illumination of a large room with this particular reflector unless a large number pointing in various directions were used on a chandelier.

Fig. 25 shows the distribution of light about a 16-cp incandescent lamp in a "Pagoda" prismatic reflector. This reflector is shown in Fig. 25A. It does not concentrate the light so much as the reflectors shown in Figs. 24 and 24A, and for that reason will be found of more general application than the former, as there are many cases where the light from the other would be too much concentrated at one point.

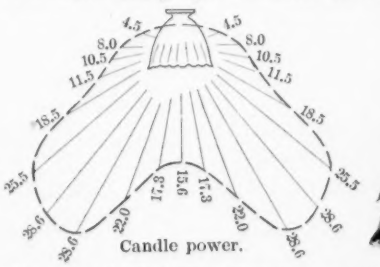
Fig. 26 shows the distribution of light about a 32-cp incandescent lamp in a "Pagoda" prismatic reflector. This reflector is shown in Fig. 26A. It represents an extreme case of concentrating light over a small area, yet at the same time a limited amount escapes through the reflector so that it is not entirely opaque. The same reflector with a 16-cp lamp gives about 120 cp at the tips. A reflector of this kind is manifestly suited only to places where a small, but very concentrated, beam of light is wanted, as in lighting store windows, draughting, lighting of small desks, and pendant reading lights used by one person only.

Fig. 27 shows the distribution of light about a 16-cp incandescent lamp in a "Pagoda" prismatic reflector. This reflector is shown in Fig. 27A. The distribution of light is in marked contrast to that in Fig. 26, as this reflector is designed to throw an even illumination over a considerable floor area below it. In fact, if the candle-power falling on a floor or table underneath this reflector



FIGS. 26 AND 26A.—DISTRIBUTION OF LIGHT FROM "PAGODA" PRISMATIC REFLECTOR.

is calculated for different points, it will be found that the illumination within 40° each way from the vertical is very nearly even. This reflector comes down over the lamp, so as to protect the eyes from the glare of the bare filament when it is hanging pendant, in much the same way as the opal dome reflector, tests on which have been shown. The contrast between Figs. 26 and 27 makes it clear how important it is to select the proper reflector for a given piece of work. It would



FIGS. 27 AND 27A.—DISTRIBUTION OF LIGHT FROM "PAGODA" PRISMATIC REFLECTOR.

evidently be a great mistake to select the concentrating reflector shown in Fig. 26 for use on a chandelier where it is desired to make one or two lights furnish general illumination for an entire small room. If this was done, the result would be very strong light immediately under the lamp if the lamp were in a pendant position (pointing straight down) and the rest of the room would receive only a small amount of light. The reflector shown in Fig. 27A would throw light evenly over the entire floor of a small room, but would not make a very intense light at any one place. It would, on the other hand, be a great mistake to put the reflector shown in Fig. 27 at the top of a store window for lighting the goods in the window, or on a chandelier for reading purposes under the chandelier.

Prismatic reflectors are also made which give a distribution of light which is a compromise between the concentration shown in Fig. 26 and the distribution shown in Fig. 27.

In the next and concluding chapter tests on some representative "Holophane" globes, shades and hemispheres will be given.

The Approximate Calculation of Plunger Electromagnets.

BY CHARLES R. UNDERHILL.

IN the calculation of the pull for electromagnets with air-gaps and particularly for plunger electromagnets, it is desirous quickly to determine the proper cross-sectional area of core or plunger to use in order to obtain a specified pull with the minimum ampere-turns, which shall be consistent with the cost of the magnet and the service required of it. It is well known that the pull between the plunger and stop of a plunger electromagnet is

$$P = \frac{B^2 A}{72134000} \qquad (1)$$

$$\text{where } B = \frac{IN}{.3133\, l} \qquad (2)$$

$$\text{Hence } P = A \left(\frac{IN}{2660\, l} \right)^2 \qquad (3)$$

all expressed in English units.

In order to determine the total pull due to a plunger electromagnet the pull due to the solenoid effect must be added to the value of P in (3)*.

It is the intention of this article merely to show graphically the relations between pull, area, ampere-turns, and length of air-gap, or stroke of plunger, as expressed by the above well-known law.

$$\text{Transposing (3)} \quad \frac{IN}{l} = 2660 \sqrt{\frac{P}{A}} \qquad (4)$$

Equation (4) shows that the ampere-turns divided by the length of the air-gap is directly proportional to the square root of the pull divided by the cross-sectional area of the air-gap between the faces of the plunger and the stop. The diameters of the plunger and the stop are assumed to be the same in this article.

By arranging the values of $2660 \sqrt{\frac{P}{A}}$ as in Fig. 1, the pull in pounds, and the cross-sectional area of the plunger or gap, in square inches may be compared, for a given value of $2660 \sqrt{\frac{P}{A}}$ and then the ampere-turns and the length of the air-gap may be compared for this same value.

As an example, assume that a pull of 85 pounds is required at the beginning of a range of 3 inches, and that the cross-sectional area of the plunger is 3 square inches. Beginning at the intersection of the ordinates representing 85 pounds pull, and 3 square inches in Fig. 1, follow the nearest diagonal to the curve. This gives the value of $2660 \sqrt{\frac{P}{A}}$ at the right as 14,000 in this case. From the point of intersection of the ordinate 14,000 with the abscissa representing the 3-in. air-gap in Fig. 2, it is seen that approximately 42,000 ampere-turns will be required.

In case the ampere-turns, range and core are given, the pull may be quickly approximated very accurately. Assume the ampere-turns to be 20000, the range or length of the gap 2 in., and the cross sectional area of the core or plunger 2 square inches. From the point of intersection of the 2-in. gap abscissa with the 20,000 ampere-turns curve of Fig. 2 it is seen that $\frac{IN}{l} = 10{,}000 = 2660 \sqrt{\frac{P}{A}}$

Following the diagonal from the curve to where it intersects the ab-

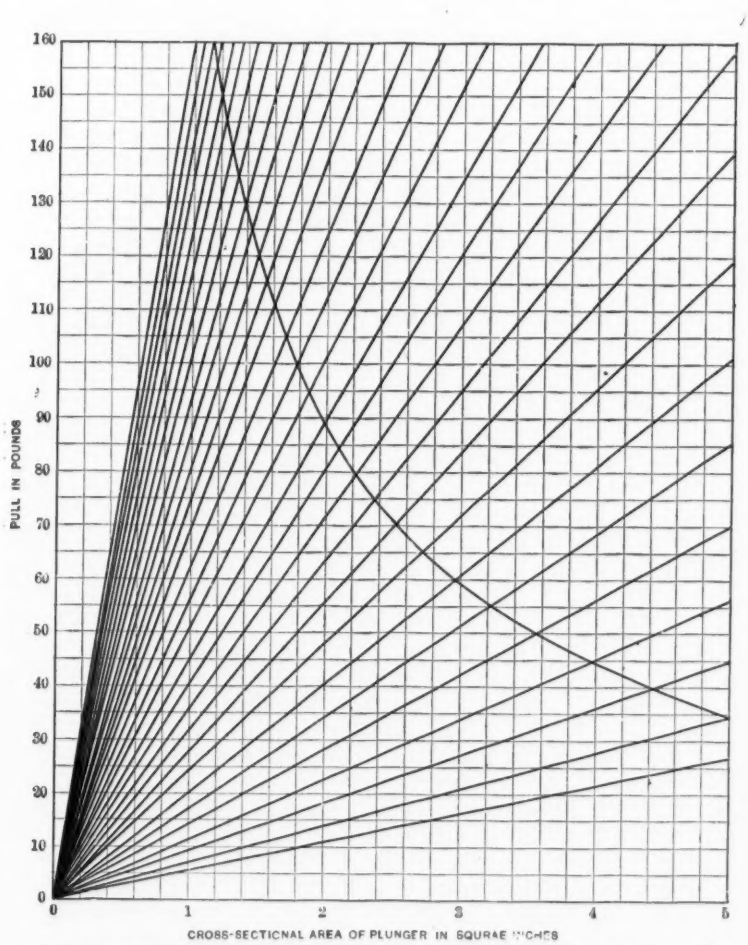


FIG. 1.—RELATION BETWEEN PULL AND CROSS-SECTIONAL AREA OF PLUNGER OR GAP.

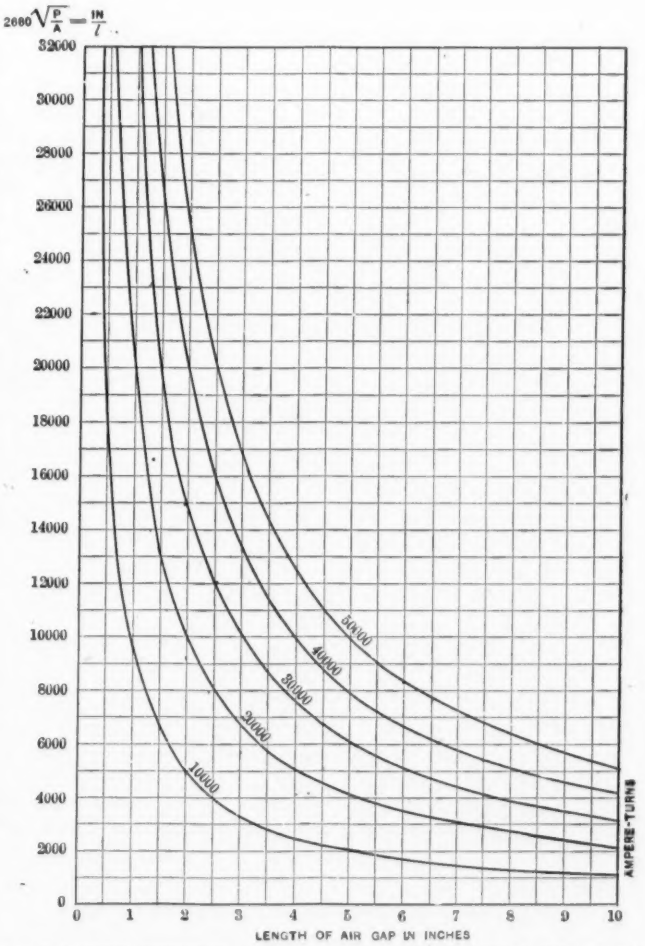


FIG. 2.—RELATION BETWEEN AIR-GAP AND AMPERE-TURNS FOR CERTAIN PULLS.

* See Elec. World & Engr., May 20, 1905; also Elec. World & Engr., June 3, 1905.

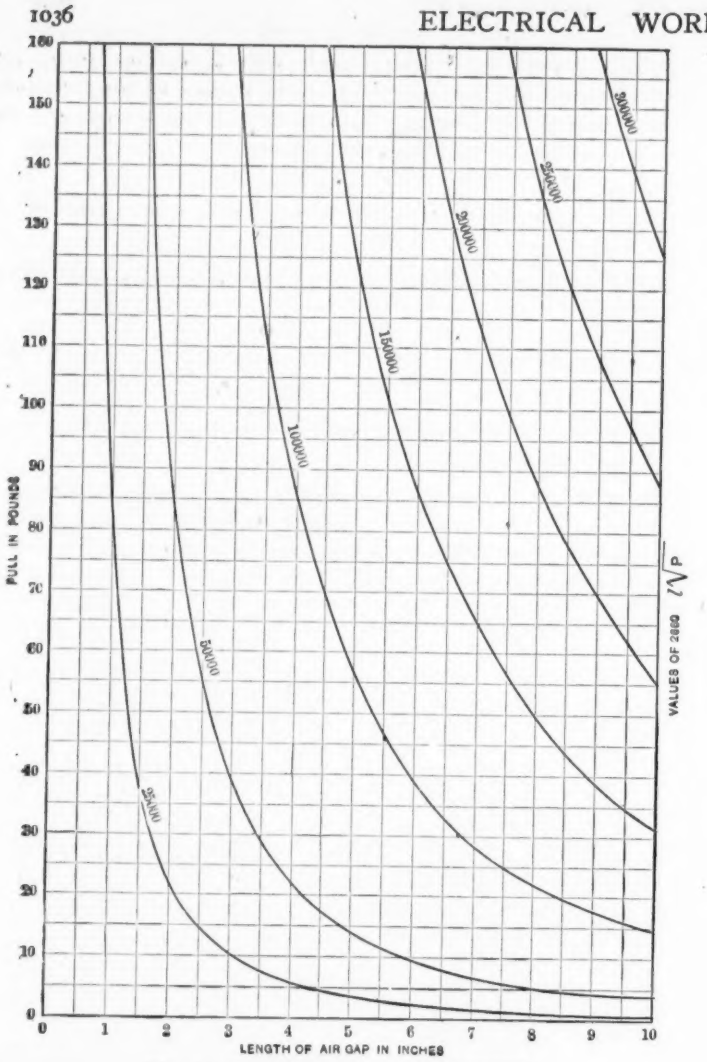


FIG. 3.—RELATION OF PULL TO LENGTH.

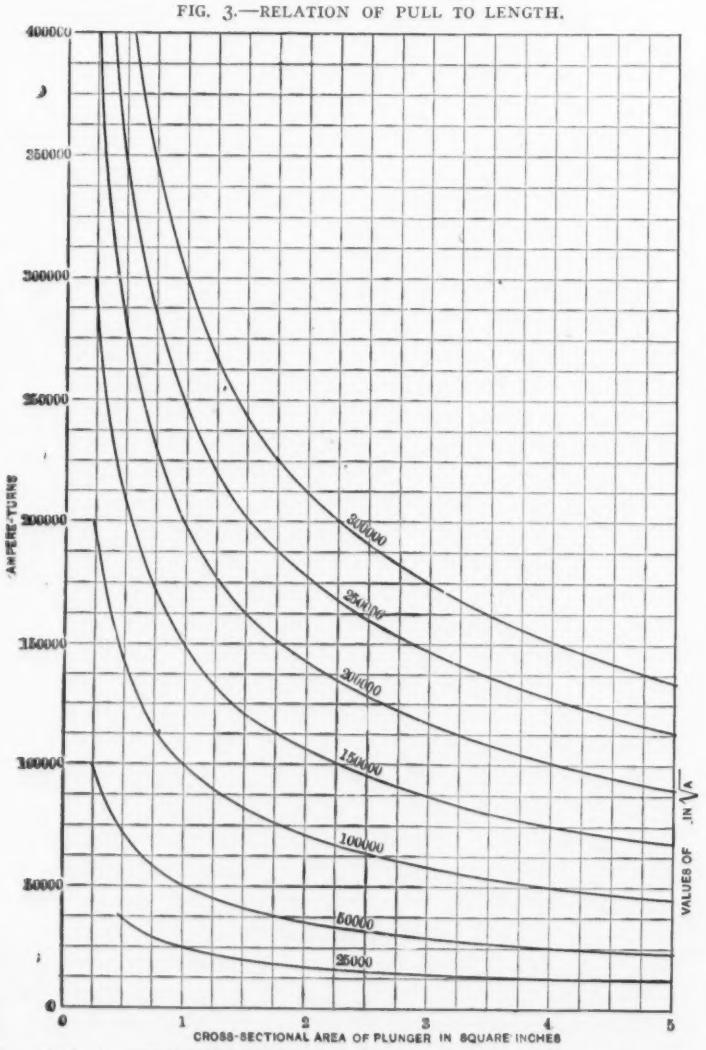


FIG. 4.—RELATION BETWEEN AREA AND MAGNETOMOTIVE FORCE.

scissa representing 2 square inches, in Fig. 1, the pull is found to be approximately 28 pounds.

Again transposing (3), $2660\,l\sqrt{P} = IN\sqrt{A}$ (5). By comparing the values of $2660\,l\sqrt{P}$ in Fig. 3 with the values of $IN\sqrt{A}$ in Fig. 4, the proper cross-section of core and the necessary ampere-turns may quickly be found for a specified pull and range.

As an example, assume that a pull of 70 pounds is required at a distance of 4½ in. Referring to Fig. 3 it is found that $2660\,l\sqrt{P}$ must equal 100,000 in order to fulfill these requirements, and, hence, $IN\sqrt{A}$ must also equal 100,000. Referring now to Fig. 4 it is seen that when $IN\sqrt{A} = 100{,}000$, any of the following values may be used:

50,000	ampere-turns	and	4	square	inches.
62,500	"	"	2.56	"	"
75,000	"	"	1.77	"	"
87,500	"	"	1.3	"	"
100,000	"	"	1.	"	"

The diameters of the plungers could, therefore, be

Area in sq. inches.	Diameter of plunger in inches.
4	2.26
2.56	1.81
1.77	1.5
1.3	1.29
1	1.13

As the diameter of the plunger is often limited by the outside diameter of the coil, or for other reasons, as for instance its inertia where a quick action is required, it often is necessary to sacrifice ampere-turns in order to reduce the cross-sectional area of the plunger, and thus keep the diameter small. This is, of course, optional with the designer, and is easily determined by reference to Fig. 4.

Recent Electrochemical Developments.

ELECTRIC FURNACE PROCESSES.

The revolution in workshop practice, brought about by the arrival of high-speed tool steels, has been intimately connected with the revolution in the ferro-alloy industry, due to the introduction of the electric furnace. It is only in the electric furnace that most high percentage ferro-alloys, low in carbon, can be made. The only process which the electric furnace industry has to compete with is the alumino-thermic method, using aluminum as the reducing agent (instead of carbon in ordinary electric furnace practice). By the alumino-thermic method several carbon-free metals, like chromium, etc., are produced. The feature which distinguishes both the electric furnace and the alumino-thermic methods from the blast furnace process is that very high temperatures may be easily obtained in the former two methods. Nevertheless, it appears that so far it has been impossible to reduce some extremely refractory oxides, like that of titanium, to the metallic state by either of the two methods. It is not strange that to reach this goal a combination of both methods is now being tried. The recent American Electrochemical Society paper of O. P. Watts described experiments made in this direction, by adding the heat of the electric arc to that of the alumino-thermic reaction.

A. J. Rossi, the pioneer of ferro-titanium, is also working in a similar direction, as shown by a patent recently granted to him. The feature which distinguishes his method from the alumino-thermic process is that he does not use finely powdered aluminum, but scrap or pieces of aluminum in any form, which he introduces first into the electric furnace. When the current is turned on the aluminum is fused. The refractory oxide to be reduced is then introduced into the fused bath of aluminum. Thus not only the electrically generated heat is utilized, but also the oxidation heat of the aluminum (of course minus the reduction heat of the oxide).

A new form of electric furnace for the production of calcium carbide has recently been patented by Appleby. It is chiefly characterized by a movable bottom so that constantly fresh portions of the charge are introduced into the zone of the stationary electrodes.

ELECTROLYSIS OF SODIUM SULPHATE.

The production of caustic soda and chlorine compounds, especially bleaching powder, by electrolysis of sodium chloride, is one of the largest electrochemical industries. The analogous problem of electrolyzing sodium sulphate has not been attacked so far on a commercial scale. The cathodic reaction is, of course, the same in both cases. The anodic reaction is different. In the case of sodium chloride electrolysis with an inert anode (like graphite or platinum)

chlorine is developed which escapes as a gas. In the case of sodium sulphate oxygen is set free and sulphuric acid is produced in the electrolyte. Hence the end products are in this case caustic soda at the cathode and sulphuric acid at the anode. This indicates at once the engineering difficulties of the problem. Both products are obtained in the solution, and it is absolutely necessary to prevent their mixing, since this would result in the reformation of sodium sulphate and a low efficiency.

H. S. Anderson endeavors in a recent patent to solve this problem by a combination of mercury cathode cell and diaphragm cell. The mercury cathode absorbs the sodium set free by the current and the caustic soda solution is produced in an outside cell, in a way familiar from the Castner-Kellner process. To prevent any sulphuric acid from coming near the mercury cathode (which is, of course, at the bottom of the electrolyzer), he provides a horizontal porous diaphragm above the mercury cathode; moreover, he passes continually a stream of fresh sodium sulphate solution between the cathode and diaphragm, so as to carry off any sulphuric acid which might pass through the diaphragm into the cathode compartment.

VARIOUS ELECTROLYTIC PROCESSES.

Several patents, recently granted to A. G. Betts and E. F. Kern, relate to details of apparatus and method of Betts' lead refining and slimes treatment processes, which have already been discussed in these columns.

Another recent patent of A. G. Betts is quite interesting from a general point of view. He improves the efficiency of an electrolytic process with an insoluble anode very materially by giving it a very quick, regular reciprocating motion. The beneficial effect is due to the fact that fresh solution is continually brought into immediate contact with the anode, and is analogous to the well-known beneficial effects of stirring, revolving cathode, etc., in the case of metal deposition.

ELECTRIC DISCHARGES THROUGH GASES.

A recent patent of E. Marquardt describes an apparatus for the production of oxides of nitrogen from air by means of electric discharges. The feature of the apparatus is that the air continually performs a cycle, passing through an arc discharge and then to a cooling and condensing apparatus, then returning to the arc and so on. The apparatus is so constructed that the gases may be maintained at any desired pressure.

A recent patent of A. C. Wood relates to details of construction of the electrodes for producing silent discharges for the manufacture of ozone from air.

These two patents have been mentioned for the sake of convenience under the same heading—electric discharges through gases. But it should not be forgotten that the two problems of producing nitric acid from air and ozone from air require very different kinds of discharges. For nitric acid production arcs are necessary, while in the production of ozone arcs would be fatal, and what is required are silent discharges.

A recent patent of A. M. Gow relates to the fixation of atmospheric nitrogen. By passing an arc discharge through a mixture of methane with nitrogen or air, he produces hydrocyanic acid. The temperature must be high enough to result in the fixation of the nitrogen, but not so high as to redecompose a part of the compounds formed.

LETTER TO THE EDITORS.

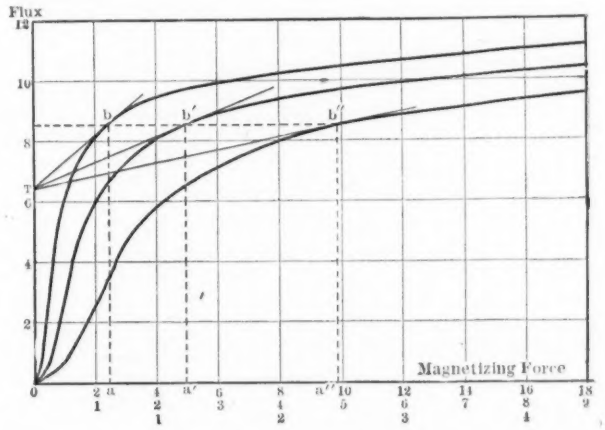
Saturation Expressed in Percent.

To the Editors of Electrical World and Engineer:

SIRS:—In speaking of the amount of saturation of a given flux path, there is no recognized standard for comparing the degree of saturation in two different cases. We say that a certain machine "is worked well up to the knee," and another "well below the knee," but this method of defining saturation is deceptive because the position of "the knee" depends upon the scales to which the saturation curve is plotted, as will be seen by the attached curves, all of which are plotted from the same data except that they are drawn to different horizontal scales.

What is desired is a definition which will indicate 100 per cent saturation for the condition in which there is no increase of flux for an increase of magnetizing force, and will indicate zero saturation for the condition in which the flux increases proportionally to the magnetizing force.

The definition derived from the following construction fulfills



SATURATION CURVE PLOTTED TO DIFFERENT HORIZONTAL SCALES.

these conditions: Draw a tangent to the saturation curve (at point under consideration) cutting the Y axis. The percentage of saturation is the percentage that the intercept ($O\,T$) on the Y axis, is of the ordinate ($a\,b$) of the point. It will be seen that this definition is independent of the scales to which the curve is plotted, as indicated by similar points (b, b' and b'') on the saturation curves shown plotted to different horizontal scales. Thus the percentage of saturation of the point b is $100 \times \frac{O\,T}{a\,b} = 75.2$.

With the above definition of per cent saturation, if a machine is said to be working at, say, 60 per cent saturation, it is known immediately that a 1 per cent increase of field current will produce a 4 per cent increase in voltage. At 80 per cent saturation a 1 per cent increase of field current will produce a 0.2 per cent increase in voltage and so on.

WILKINSBURG, PA. H. S. BAKER.

DIGEST OF CURRENT ELECTRICAL LITERATURE

DYNAMOS, MOTORS AND TRANSFORMERS.

Induction Motor.—In notes on the recent Olympia Exhibition in London, induction motors made by Siemens Brothers are mentioned in which the rotor-starting resistance is carried on the rotor itself and is switched out without assistance of external connections. The gear for switching out the resistance is shown in Fig. 1 in its final position, i. e., with all the extra resistance cut out from the rotor circuit. In starting up the position of the auxiliary plunger, B, is such that the roller, C, engages with Vee slot 1. As the screw, M, is rotated by means of the hand wheel, L, it forces the bush, E, from left to right, and the pull is transmitted to the auxiliary plunger, B, causing the latter to force back plunger F against the action of the spring, G. The hand wheel is slowly rotated until such a position is reached that the action of spring D overcomes the action of the plunger F, thus causing the plunger B to jump until the roller C occupies Vee slot 2. This movement is immediately taken up by plunger A under the action of plunger B. In moving the plunger A carries with it the pin, H, which, rolling in a spiral slot in the collar, J, gives to the latter a rotary motion. The collar, J, carries the blade, K, which intermittently short-circuits the contacts A', B', C' and D'. If the hand wheel, L, is still rotated, then the movement of plungers A and B is repeated and the roller, C, successively occupies the Vee slots 1, 2, 3 and 4. The number of Vee slots corresponds to the number of resistance contacts, and the blade, K, occupies a definite position when the roller, C, is in any one of the Vee slots. N is an indicator working in a slot, O, which reveals to the operator the position of the blade, K. The whole of the mechanism for the intermittent motion is entirely enclosed in

a cast-iron case, *P*, and secured to the end of the bearing of the motor. *Q* is a screwed plug for adjustment of the spring, *G*, and the

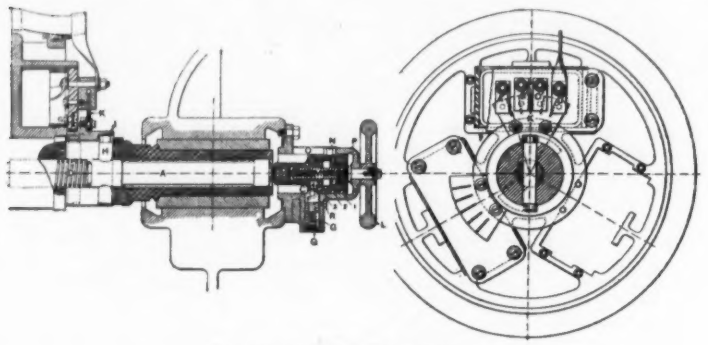


FIG. 1.—INDUCTION MOTOR.

plunger, *F*, is prevented from rotating by the action of the screw, *R*, sliding in a keyway.—Lond. *Elec.*, November 17.

Single-Phase Motor.—Among notes on the recent Olympia Electrical Exposition in London, a single-phase elevator motor of the "reactance type" is mentioned, built by Crompton & Company and designed to start against heavy torques with a small starting current. The motor in question was designed to give 10 hp under ordinary lift conditions, and to run at a speed of 750 r.p.m. The rotor is of the usual construction, provided with three-phase, star-connected winding, the neutral and the free ends of the winding being connected to a special form of slip ring. There are three or more of these rings. On each ring is fitted a number of insulated bars equal to the number of poles on the motor, and spaced equidistantly on the rings. These insulated bars are all connected to the neutral point of the rotor winding and the action of the motor when starting is as follows: When one of the brushes is in a position to connect the insulated bar and ring, it short-circuits one of the rotor phases and produces a repulsion torque. By properly staggering the brushes on the different rings, a continuous repulsion torque is obtained. The brushes on the rings are also connected to an ordinary starting resistance, this resistance being gradually cut out. As soon as the motor has reached its normal speed and the starting resistance is short-circuited, the machine acts as an ordinary induction motor, and runs practically at synchronous speed, irrespective of the load. When used for lift or crane work the motor can be reversed by shifting the brush gear through a small angle, and for this purpose the brush gear is connected mechanically to the controller. The rotor circuit is quite distinct from the stator circuit, so that the rotor and starting resistance can be arranged for low voltage. The special starting switch for use with these motors resembles a three-phase reversing switch with several starting contacts, but the movement of the switch arm in each direction is controlled by a dash-pot, so that however rapidly the lift rope may be pulled the motor is still switched on slowly. A device is added, however, which causes the switch to return to the "off" position with a quick motion, the dash-pot only acting when the switch is moving to the full-speed position in each direction.—Lond. *Elec.*, November 10.

Dynamos with Interpoles.—An illustrated article stating that the British firm of Thomas Parker has begun using auxiliary commutation poles to a very large extent on all kinds of dynamos from 500 kw down to motors of 10 hp. The auxiliary poles are, however, not fitted to all standard machines, but only to those in which the inductance of the armature coils is high. Since it is not necessary to shift the brushes of machines with auxiliary poles, it is customary to omit the usual brush-rocking devices, the brush gear being "pegged" in one position after the test. The section of the auxiliary poles is made larger or smaller according to the reactance of the armature coils to be balanced. The straight lines in Fig. 2 indicate the sparking limits of such machines fitted with auxiliary poles. Fig. 2 relates to a 200-volt, 500-amp., four-pole dynamo designed to run at 350 r.p.m. The greater the distance between the two parallel lines, the larger the overload capacity and the greater the movement of the brushes around the commutator without sparking. The latter possibly may be utilized for varying the speed of motors, and, in dynamos, for making use of the compounding effect of the armature ampere-turns. For instance, the speed of a 250-volt, 30-hp motor can be varied between 980 and 1,180 r.p.m. by merely shifting the brushes. In an editorial note it is stated that the shifting of the brushes out of their "best" position always leads to a reduction of the efficiency. One of the reasons for the adoption of auxiliary poles is to enable wide speed variation to be effected with the ordinary field rheostat without its being necessary to shift the brushes to avoid sparking. The other reasons for this special construction, applicable in the case of generators as well as motors, is to diminish the size and cost of those machines which have hitherto had to be designed on the basis of the limit due to sparking

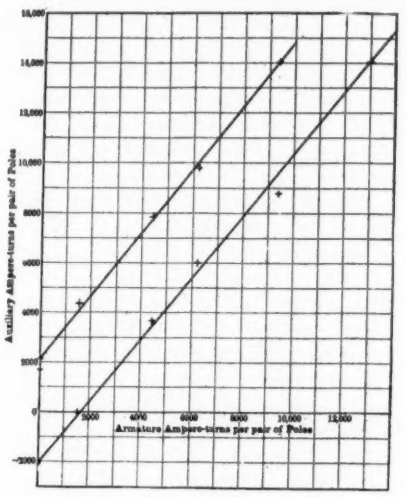


FIG. 2.—INTER-POLE DYNAMOS.

instead of that due exclusively to the temperature rise.—Lond. *Elec.*, November 24.

Commutation Poles.—ARNOLD.—A mathematical article on the theory of direct-current dynamos with commutation poles.—*Zeit. f. Elek.* (Vienna), November 26.

Liege Exposition.—REYVAL.—An illustrated description of several machines exhibited at Liege by the firm of Pieper. One is the steam-driven, 400-kw, 440-volt, direct-current machine, second a steam-driven, 90-kw, 440-volt, direct-current machine, and the third a gas-driven, 500-kw, direct-current machine. The gas engine will be operated with coke oven gas, but at the Exposition in Liege it is operated from the municipal gas supply. Illustrations and detailed dimensions are given of each of the machines.—*L'Eclairage Elec.*, November 25.

LIGHTS AND LIGHTING.

Flame Arc Lamp.—In notes on the recent Olympia Electrical Exposition in London a new flame arc lamp of the Armorduct Manufacturing Company is mentioned. This lamp is of the converging carbon type with magnetic blow-out, differentially wound and escapement controlled. The magnetic blow-out coil has a double winding. One of these windings is in circuit when the lamp is burning, and creates a weak magnetic field in which the flame is maintained. The second winding is brought into use when the carbons are burned out. This is effected by an automatic switch which serves the dual purpose of cutting out the shunt coil, and at the same time switching in the second winding of the blow-out coil, which effectually blows out the arc. The clockwork mechanism is simple and is actuated by weights to which the carbon holders are fixed, the escapement being released by means of the differential coils, and dash-pot. The weights and carbon holders are fitted with roller bearings throughout, by which means the friction is reduced to a minimum and the makers state that it is practically impossible for the carbons to stick, so that there is a perfectly steady feed. The whole of the mechanism is protected from the fumes given off by the sodium-cored carbons. The lamps are designed for both continuous and alternating current in the following sizes: Direct-current, 6, 8, 10 and 12 amp. (burning hours 7 to 19); alternating-current, 8, 10, 12 and 15 amp. (burning hours 7 to 17). Terminal voltage from 45 to 48. The hemispherical candle-power is stated to be approximately as follows: 6 amp., 1,750 cp; 8 amp., 2,500 cp; 10 amp., 3,600 cp; 12 amp., 4,750 cp.—Lond. *Elec.*, November 17.

Arc Lamp.—An illustrated note on the last design of the Jandus arc lamp. In the mechanism of the lamp is a compound-wound solenoid which acts on an armature of nearly three pounds weight. The great inertia of this heavy weight steadies small fluctuations.

The manufacturer still adheres to the use of powerful shunt coils for series lamps (these coils balancing the arc voltages within one or two volts), and does not rely on the use of series coils only for the regulation of the arc voltage. It is stated that the present lamp will burn for 200 hours at one trimming without any blackening of the globe, flickering of the light or explosions.—Lond. *Elec.*, November 17.

Train Lighting.—DICK.—A lecture on the systems of train lighting in which both a dynamo and storage battery are used. There are two different methods. The first is to have on the locomotive only one dynamo, which is connected with all the cars and batteries. The second method is to have both a dynamo and a storage battery on each car. The author believes that the latter system is the only practical one. He reviews the general principles of the same and also gives some data on the cost. He claims that electric lighting by this method is able to compete with any other kind of lighting.—*Zeit. f. Elek.* (Vienna), November 26.

Mercury Arc Lamp.—LETHEULE.—A summary of a recent paper of Leblanc on the researches of Cooper Hewitt and his co-workers on the mercury vapor lamp and rectifier.—*Revue Gen. des Sciences.*—November 15.

POWER.

Refuse Destruction.—An article on the new refuse destruction plant of the city of Fiume. Daily 20 to 22 tons of refuse are collected, of which one-third is refuse from the streets. At the test of the plant 8.3 tons of refuse were burned in six hours, which represented 345.75 kg. per square meter of grate and per hour. The evaporation amounted to 1.034 kg. of water per 1 kg. of refuse. It is stated that this is considerably better than the result obtained in a similar plant in Zurich. The refuse destructor is operated in connection with a three-phase generating plant.—*Zeit. f. Elek.* (Vienna), November 12.

Power Supply in London.—A reprint of the report of the Financial Committee of the London County Council in opposition to the Highways Committee on electric power supply in London, and an editorial discussion of the subject.—Lond. *Elec.*, November 17.

Lubrication.—STROHM.—An article of a practical nature, illustrated by diagrams, on steam engine lubrication.—*Am. Elec.*, December.

Electric Crane.—An illustrated description of a large electric crane, its lifting capacity being 50 tons at a maximum radius of 87 ft.—*Scien. Am. Sup.*, November 25.

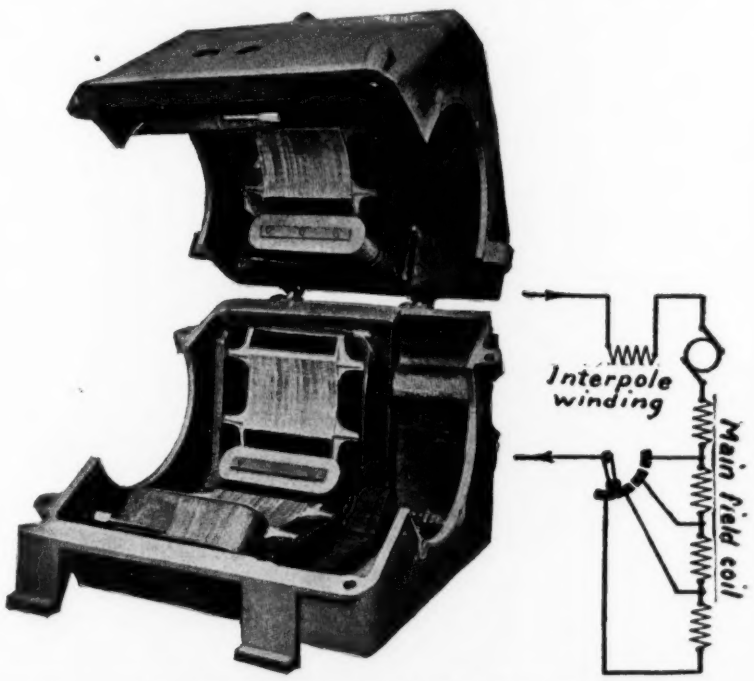
Turbo-Generator.—SCHULTE.—A description of the new 1,000-kw turbo-generator at the Courl mine in Germany. It consists of a Zoelly steam turbine directly coupled with a 1,500-hp, three-phase generator, the speed being 1,500 r.p.m.—*Glueckauf*, November 11.

TRACTION.

Brakes.—In tramcars whose brakes are applied by the action of an electromagnet, it has been the practice to keep the brake in the "on" position by a ratchet and pawl arrangement. This locking device has recently been displaced to a large extent in Germany by a hydraulic arrangement. The plunger of the electromagnet takes the form of a piston moving within a cylinder. When the plunger is sucked up into its solenoid against the pressure of a spring, liquid is drawn into the cylinder from a small tank. If, now, the current to the electromagnet be interrupted, the plunger cannot move backwards, because the liquid previously drawn through the non-return valve cannot escape, and, therefore, the brakes cannot come off. This valve can be lifted to a smaller or greater extent by a separate electromagnet of small dimensions. The application of the brake and the release valve is governed by a small controller near the car driver. The handle of this controller is capable, not only of being rotated, but also of being moved up and down. While a rotary movement of the handle causes more or less current to flow through the main electromagnet, the up or down movement of the handle makes or breaks contact with the small electromagnet. The total weight of the apparatus described, including the brake controller, is stated to be 150 kg. (330 lbs.).—Lond. *Elec.*, November 17.

Trolley Wheels.—COOPER.—Some notes on trolley wheels. The writer points out that a trolley wheel should be soft and of as good conductivity as possible, otherwise the wire will suffer instead of the wheel, and it is much cheaper to renew the wheels than the wire. The author points out the very great importance of the absolute balancing of the wheel and the exact centering of the bush in the wheel, and of the hole of the bushing itself. With respect to the pressure of the trolley wheel against the wire, he says that this depends very largely upon the height of the wire, the size of the wheel, the character of the overhead work and the speed of the car. For ordinary urban work where the average speed of the car does not go over 10 m.p.h. a pressure of 15 lbs. will give perfect contact at the end of a 12-ft. trolley pole, provided that the overhead work is not so high that the trolley is to assume an angle of over 75°. From this, which is the lightest safe pressure that can be used, the pressure will run up to 35 lbs. on high-speed interurban lines using large and heavy wheels. The writer describes a simple method of measuring the pressure against the wire.—*St. R'y. Jour.*, December 2.

New Direct-Current Traction Motor.—An illustrated description of a new direct-current traction motor of the Oerlikon Company. It is designed for a load of 200 hp during one hour at voltages up to 800 and at 400 revolutions. An interesting feature is that the motor is equipped with commutation poles ("interpoles"), as



FIGS. 3 AND 4.—NEW TRACTION MOTOR AND DIAGRAM OF WINDINGS.

shown in Fig. 3. The slots of the armature are entirely closed. The highest speed which may be used is 1,000, the peripheral speed of the commutator being in this case 25 meters. The armature contains 518 bars, two per slot, and the commutator has 259 segments. The exciting coils are made from copper ribbon and are insulated with presspahn, there being no cotton insulation whatever. The method of speed regulation is indicated in Fig. 4, which shows that one or more portions of the windings of the main poles may be disconnected.—*Elek. Bahnen*, November 14.

Electric Locomotives.—An illustrated description of the new electric locomotives which will displace those now driven by steam which haul the London & North Western trains from the Mansion House to Broad Street, via Willesden. Each locomotive has four motors each of 200 hp and the multiple unit control system will be used.—Lond. *Elec.*, November 17.

Petrol Motor.—A fully illustrated description of a 140-hp Wolseley petrol motor weighing only 80 cwt. The placing of the order for this motor was influenced largely by the success of similar Wolseley engines employed by the North Eastern Railway Company to drive electric generators for supplying current to motors operating passenger coaches in use on local lines. The new motor is built by the General Electric Company of this country and is to be applied to the same purpose on one of the American lines.—Lond. *Eng'ing*, November 10.

Surface Contact Systems.—An illustrated description, with some critical comment, of the four surface contact systems in England which are "alive or in a state of partially suspended animation." These four systems are the Lorain, the Dolter, the G.B. system, and

the Kingsland. The anonymous writer appears to favor the Kingsland system.—Lond. *Elec. Rev.*, November 10.

Storage Battery Locomotive.—An illustrated description of an electric storage battery locomotive for construction and emergency use in one of the new deep-level subways in London.—*Scien. Am.*, November 25.

High-Speed Traction.—The conclusion of the voluminous report, giving detailed and very valuable information on the high-speed traction tests between Berlin and Zossen. The concluding section is devoted mainly to a discussion of the measurement of the energy consumption and to the results of the braking tests of 1902, and contains numerous tables, drawings and diagrams.—*St. R'y. Jour.*, December 2.

INSTALLATIONS. SYSTEMS AND APPLIANCES.

Vulcanized Fibre.—WERNICKE.—An account of some trials of vulcanized fibre as insulating material. It was found that vulcanized fibre when dry is a pretty good insulating material, but in moist air—i.e., under conditions as they generally exist in free air or in many installations—it is entirely unsuitable since it easily absorbs considerable amounts of moisture and gives them off only slowly later on. Some notes are given on the development of blisters on the surface of the insulator when heated under certain conditions. *Elek. Zeit.*, November 23.

Electricity in Hospital.—A long and fully illustrated description of the electrical equipment in the London hospital. The installation comprises nearly 6,000 lights and about 100 motors, and there is a complete equipment for the application of Roentgen rays, high frequency oscillations, the treatment of lupus by means of Finsen light, etc.—Lond. *Elec. Rev.*, November 10.

WIRES, WIRING AND CONDUITS.

Lead-Covered Wiring.—MACKENZIE.—A discussion of the advantages and disadvantages of lead-covered wiring. The advantages are given as follows: The wire comes to the contractor, already provided with its own continuous metallic sheathing, and generally requires no further protection. The sheathing is water tight, and the whole installation can quite readily be made so too. The great flexibility of the wire enables it to be installed with much less damage to buildings. The small diameter of the wire enables it to be used in surface work, where any other system would be an eyesore. The difficulty in making joints practically compels the adoption of a loop-in system. The disadvantages urged against the system are many and various, but fall under two general heads, viz: First, risk of injury during erection from carelessness of the wiremen and other workingmen, and second, risk of injury after erection. Among the latter risk the author mentions that if a failure of insulation takes place, a wire connot readily be withdrawn and replaced. He says that this is the only point where conduit systems can show any real superiority over the lead-covered. Another risk is that lead expands with increase of temperature and may not go back to its original length when cold, and hence it may come in contact with other metals or may even get cracked and broken. For this reason, where wire is to be subjected to very great variations in temperature lead should not be used, but this is never the case in houses or shops under ordinary circumstances. Another risk is that the electric resistance of lead being high, contact with other metals may form a better "earth" than the proper earth connection; when the earth appears, the lead may fuse at the point of contact as quickly as the fuse wire does. In order to overcome these disadvantages, it is sufficient to bond all the lead wires together at frequent intervals and so get the advantage of all the sheathing. For this purpose the writer uses a solder containing a large proportion of lead. Since the presence of other metals such as brass saddles in damp situations may cause electrolytic action, lead saddles should be used, which are quite as sufficient. The author claims that, if properly handled, lead-covered wiring is good. It is often very improperly applied, however. He mentions a case where lead-covered wires had been drawn into iron gas pipes laid in the ground, whereby the lead covering had been scratched and perhaps cut with the inevitable result of breakdown. Instead of this method the wire ought to have been laid either in wood troughing and pitched in solid or drawn into smooth earthenware or concrete conduits.—Lond. *Elec. Rev.*, November 10.

Making Copper Wire.—An illustrated description of a method of Cowper-Coles for making copper wire by means of the centrifugal electrolytic process. A revolving mandrel is provided with a spiral scratch. The effect of this scratch which must be angular is to disturb the molecular structure of the electro-deposited copper and to form a cleavage plane. When the deposit has reached a sufficient thickness the current is interrupted and the deposit can be taken off in form of a helix, the copper parting along the line of scratch.—Lond. *Elec.*, November 10.

ELECTROPHYSICS AND MAGNETISM.

Magnetization Within Wide Limits of Temperature.—HONDA AND SHIMIZU.—The first part of a paper, giving an account of a very extended investigation of the magnetization and the magnetic change of length in ferro-magnetic metals and alloys at temperatures ranging from 186° C. to + 1,200° C. In Swedish iron, tungsten-steel and nickel, the cooling by liquid air diminishes the magnetization in low fields, but increases it in the strong. In Swedish iron and tungsten-steel the change is very small, amounting at most to 2 or 3 per cent; but in nickel the initial diminution is considerably larger, amounting to about 10 per cent in the maximum. As in the case of iron, tungsten-steel, and nickel, the magnetization of the alloys of nickel-steels containing amounts of nickel greater than 26.64 per cent is decreased in weak fields and increased in strong, by cooling them in liquid air. In alloys containing lower percentages of nickel, the magnetization always increases on cooling. Steinmetz's formula giving the relation between the hysteresis loss and the maximum induction holds for nickel and annealed cobalt up to an induction of 3,000 c.g.s.; it holds for cast cobalt and tungsten-steel up to 8,000 c.g.s.; and, lastly, for Swedish iron, it fails beyond an induction of 18,000 c.g.s. If, however, the specimens are cooled in liquid air, the applicable range of the law for induction is notably extended, as regards the residual magnetism, the cooling always increases it in a marked degree. The hysteresis loss of nickel-steels at ordinary temperature is generally small, compared with that of other ferro-magnetic metals. In Swedish iron and tungsten-steel, cooling by liquid air decreases the elongation of the metals; the change in tungsten-steel is very small, but in Swedish iron it is relatively large. In nickel, the contraction is diminished by cooling to a field of 670 c.g.s.; but it is increased in stronger fields. The paper is to be concluded.—*Phil. Mag.*, November.

Radiations Given off in an Alternating Condenser Field.—SANFORD.—An account of measurements of the wave length of the radiation from different metals, when these metals are joined to the cathode of the secondary of an induction coil or are placed in the field of an air condenser, the plates of which are joined to the terminals of an induction coil. In general the radiation from each metal seems very homogeneous. The wave lengths from the different metals tested vary between 330 and 400$\mu\mu$.—*Phys. Rev.*, November.

Measuring Conductivity of Air.—GARDIEN.—An illustrated description of an apparatus for measuring the absolute conductivity of air. It consists of two concentric cylinder electrodes between which the air stream is passed. The result is independent of the speed of the air.—*Phys. Zeit.*, November 9.

Speed of Roentgen Rays.—MARX.—The complete paper with illustrations and diagrams of his measuring arrangements, an abstract of which was recently noticed in the Digest.—*Phys. Zeit.*, November 9.

Electricity in Gases.—STARK.—A paper giving the present situation of the investigation of electricity in gases.—*Phys. Zeit.*, November 9.

Congress of German Naturalists.—An account of the proceedings of the 77th meeting held by the Association of German Naturalists and Physicians in Meran from September 24 to 30, 1905. Those papers which refer to electrical subjects have been or will be abstracted in the Digest.—*Phys. Zeit.*, November 9

ELECTROCHEMISTRY AND BATTERIES.

Storage Battery.—GRADENWITZ.—An illustrated description of the Ziegenberg lead-zinc storage battery with some notes showing how to use it under certain circumstances as primary battery. The battery is discussed in an editorial.—*Am. Elec.*, December.

Copper Oxide Cell.—RAMMELSBERG.—Some notes on the rational reoxidation of the copper electrode of copper oxide cell.—*Centralbl. f. Accum.*, November 1.

Physical Chemistry.—VAN'T HOFF.—His full paper presented before the International Congress of Arts and Science last year on the re-

lation of physical chemistry to physics and chemistry.—*Science*, November 24.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Transformer Arrangement for Testing Purposes.—McCARTY.—In testing induction motors in large numbers it is very desirable to run a number at the same time. For this purpose it is necessary to get as many voltage combinations as possible from a restricted number of transformers. The author discusses the different arrangements which are possible with two single-phase transformers. Assuming a line e.m.f. of 220 volts, two-phase, Fig. 5 indicates the phases and

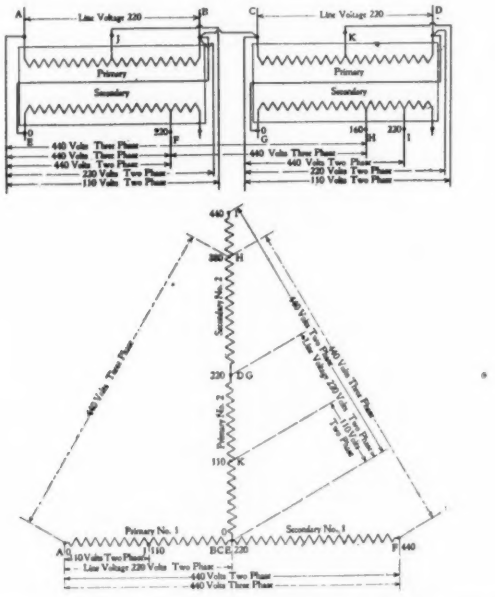


FIG. 5.—ARRANGEMENT OF TRANSFORMERS FOR TESTING PURPOSES.

voltages that may be secured from two single-phase transformers. The upper part of the figure shows the connections as they are made on the transformers referred to. In the lower part of the figure the same connections are shown but given in the more usual diagrammatic form for two-to-three-phase transformation.—*Elec. Jour.*, November.

Theory of Phase Meters.—SUMPNER.—An abstract of a (British) Physical Soc. paper on the construction and theory of phase meters. The main results of the author were as follows: Phase meters for multiphase circuits are all equally accurate on balanced loads, provided they have been correctly calibrated and possess no faults due to purely mechanical causes. Their accuracy is not affected by variations in wave form or in current frequency. The calibration of the scale is affected by the number of coils used in the instrument, by the ratios of the ampere-turns used with these coils, by the distribution of the windings, and by the magnetic nature and properties of the magnetic circuits, especially if these contain iron; but the accuracy of the indications is not dependent upon any of these considerations, if the working of the instrument is satisfactory from a mechanical point of view. Phase-meters can be simply and accurately calibrated for balanced loads by means of a direct-current method of test. The error of phase-meters on unbalanced circuits is generally serious for loads which are badly out of balance. The error, like that of a wattmeter, increases rapidly as the power factor of the load diminishes. It can only be reduced at the expense of complication in the instrument, by increasing the number of coils used in the fixed and moving systems, and by arranging the coils and magnetic circuits to be symmetrical in regard to one another. If the true power factor of the load is $\cos \phi$, the reading of the instrument is $\cos \phi + \beta \sin \phi$, where β is the phase error due to the unbalanced load.—Lond. *Elec. Eng.*, November 3.

Reading Error of Indicating Instruments.—BRACKETT.—An article pointing out the importance of users of instruments understanding the limits of accuracy in reading. A curve is given referring to a uniform-scale direct-reading ammeter of the range from 0 to 100 amperes. The author shows how the per cent error caused by an uncertainty of one-tenth of one scale division changes with the number of amperes read off. Since the smallest of the scale divisions represents one ampere, the reading of the position of its pointer can be made to the accuracy of one-tenth of one ampere, without any consideration of the size of the reading. This uncertainty of one-tenth of one ampere is only one-tenth of one per cent when the current read is 100 amperes, but it becomes one per cent when the instrument is used to measure ten amperes, and for currents less than ten amperes the uncertainty or the possible error in the reading of the instrument, even when its indications are absolutely correct, increases in a most remarkable way. When a direct-reading instrument has a scale that is more open at its middle with smaller divisions at the ends, the uncertainty of low readings is necessarily greater and the point where reasonable accuracy may be secured is not reached until the quantities measured are relatively much larger.—*Elec. Jour.*, November.

Dynamometer.—GUARINI.—An illustrated description of a new dynamometer built by J. J. Rieter & Co., for a capacity of about 12 hp. —*Am. Machinist*, November 16.

Air Pump.—GAEDE.—A description of a new revolving mercury air pump.—*Phys. Zeit.*, November 9.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Directed Wireless Telegraphy.—BRAUN.—An account of some experiments made by him in Strassburg on sending wireless telegraph messages in a certain direction only. The method is based on the possibility of producing two high-frequency electric oscillations of equal amplitude and frequency, but differing in phase by portions of one millionth of a second. After methods for this purpose had been developed the actual tests were made by an arrangement shown in Fig. 6, which shows the transmitting station. It comprises three wooden masts which are placed at equal distances of 30 meters from each other. An insulated copper wire goes from the top of each mast to the bottom and from there to the wooden shanty in the center which contains the apparatus. From there, the three electric oscillations are impressed on the three wires. The principle of the method may be understood from the following consideration: The wires 1 and 2 may receive absolutely identical oscillations, while the wire 3 may get an oscillation which is slightly lacking in phase behind that of the two others; then the wave emitted from the latter will lag still more in phase when it reaches the line between 1 and 2. This total phase difference may be adjusted so that the wave from 3 annihilates the waves going out from 1 and 2. On the other hand, if the wire 3 be supplied with the oscillations ahead in phase before those of 1 and 2, then the wave emitted

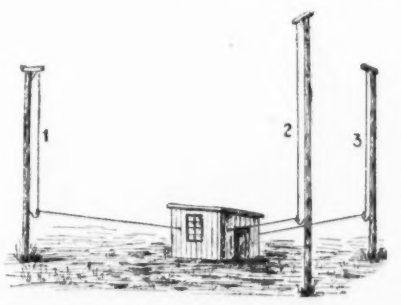


FIG. 6.—WIRELESS TELEGRAPHY.

from 3 may strengthen the waves from 1 and 2. It is thus possible to annihilate or strengthen at will any wave going from 3 towards 1—2. The experimental results agreed exactly with the theory. If one uses five vertical masts in proper positions it is possible to direct a wave quite precisely in a certain direction.—*Elek. u. Polyt. Rundschau*, November 1.

Wireless Telegraphy.—SLABY.—A further paper in his serial on tuned wireless telegraphy. In the present installment he deals with indirectly excited transmitters with a decreased damping effect. He gives a complete theory of the "coupled" transmitter, and gives formulas for calculating the wave lengths of the two waves produced in it. Actual measurements have shown his formulas to be exact.—*Elek. Zeit.*, November 9.

Telephone Switchboard.—An illustrated description of a new telephone switchboard which has been specially built for use in connection with the distribution system of the Lancashire Electric Power Company. Its special feature lies in the precautions which have been taken to guard the operator against any shock from the 10,000-volt overhead transmission line.—Lond. *Elec.*, November 17.

Telephone Lamps.—An illustrated description of the more impor-

tant commercial incandescent lamps for telephone service.—*Dingler's Polyt. Jour.*, November 11, 18.

Miscellaneous.

Liege Exposition.—Fully illustrated descriptions by Orban of the exhibits of the electric generating sets, prime movers, electric capstans and electric lighting systems for railway trains, also an article by Pierart on telegraph exhibits.—*Bull. Mensuel. Soc. Belge Elec.*, November.

Electric Heating.—Jepson.—A well illustrated article on the history and development of electric heating.—*Elec. Age*, November.

Magnetic Separator.—An illustrated description of the Ball & Norton belt-type magnetic separator.—*Iron Age*, November 23.

Soldering.—In an article entitled "Experience on the Road," some practical notes are given on soldering, especially in connection with heavy cable terminals and bar windings.—*Elec. Jour.*, November.

Electric Manufacturing Works.—An illustrated description of the East Pilton Works of Bruce Peebles & Company, Ltd.—Lond. *Elec. Rev.*, November 17.

Niagara Falls.—Lincoln.—Reminiscences on electrical engineering at Niagara Falls.—*Elec. Age*, November.

Biographical.—A biographical sketch of the new president of the British Institution of Electrical Engineers, Mr. John Gavey, who is a distinguished British telegraph and telephone engineer.—Lond. *Elec. Rev.*, November 3.

BOOK REVIEW.

Elemente der Vektor-Analysis. Second Edition. By A. H. Bucherer. Leipzig: B. G. Teubner. 103 pages, illustrated. Price, 2.40 marks.

The study of vector analysis is daily becoming more important in dealing with quantitative physics, and theoretical mechanics. This little volume gives a brief account of the principles of vectors from the quaternion standpoint as interpreted by Heaviside and Föppl. As a compendium of the fundamental space theorems of physics and mechanics expressed in vector notation, the book will be of service to advanced students in mathematics.

Books Received.

Die Aufgaben der Photochemie. By Dr. R. Luther. Leipzig: Johann Ambrosius Barth. 18 pages. Price, 80 pfennigs.

Die Elektrochemie der Organischen Verbindungen. By Dr. Walther Lob. Halle: Wilhelm Knapp. 320 pages, illustrated. Price, 9 marks.

Theoretische Elektrochemie. By Dr. Heinrich Dannee. Leipzig: C. J. Goeschen. 197 pages, 18 illustrations. Price, 80 pfennigs.

Elektrolyse Geschmolzener Salze. By Richard Lorenz. Vols. I and II. Halle: Wilhelm Knapp. Vol. I, 217 pages; Vol. II, 257 pages. Price, 8 marks.

Traité Pratique D'Électrochemie. By Richard Lorenz. Paris: Gauthier-Villars. 323 pages, 77 illustrations. Price, 9 francs.

The Allis-Chalmers Steam Turbine.

The first steam turbine installed by the Allis-Chalmers Company is now in operation in the Washington Street power house of the Utica Gas & Electric Company, Utica, N. Y. This turbine, shown in Fig. 2, is rated at 1,500 kw normal load, and runs at a speed of 1,800 r.p.m. It is direct coupled to an Allis-Chalmers two-phase, 60-cycle, revolving-field alternator, operating at 2,500 volts. The unit has a continuous overload capacity of 25 per cent, with a three-hour 50 per cent overload capacity without exceeding a safe generator temperature, and capable of a 100 per cent safe momentary overload. Artificial ventilation by means of an electrically-driven fan blower will, however, enable the unit to be run safely beyond its rated overload capacity.

The turbine follows the well-known Parsons type which has proven itself eminently successful in numerous installations both here and abroad. The Allis-Chalmers construction, however, embodies a number of features which are new in this country, and which are claimed by the builders to be distinct improvements.

The chief distinguishing feature of this construction is the blading, which, while it is of the Parsons reaction type as regards the principle of operation, differs in mechanical construction in a number of essential details. The roots of the blades are formed in dovetail shape by special machinery, and are inserted in slots cut in foundation or base rings, these slots being formed by special machine tools in such a way as to exactly conform to the shapes of the blade roots. The foundation rings themselves are of dovetail shape in cross section and are inserted in dovetailed grooves cut in the turbine cylinder and spindle respectively, in which they are firmly held by key pieces, much in the same way that the well known "Lewis bolt" is fastened. In order further to ensure the integrity of the construction, the key pieces or rings after being driven into place are upset into undercut grooves.

Another noticeable feature of the blading is the method of reinforcing and protecting the tips of the blades. This point in steam turbine design is one upon which much thought has been expended by various inventors, and the Allis-Chalmers Company claims that the construction employed by it successfully solves all difficulties.

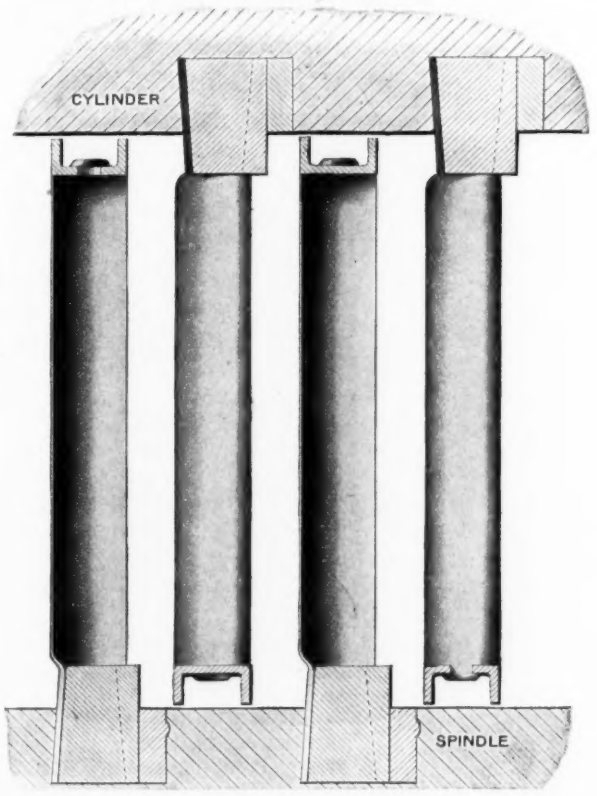


FIG. 1.—METHOD OF FASTENING BLADES.

In forming the blades a shouldered projection is left at the tip. This is inserted in a slot punched in a shroud ring, the slots being punched by special machinery in such a way as to produce accurate spacing and at the same time form the slots so that they will give the proper angles to the blades independent of the slots in the base ring. After the blade tips are inserted in the slots in the shroud rings they are riveted over by specially arranged pneumatic machinery.

The shroud rings are made in channel shape, with outwardly projecting flanges which, after assembly in the turbine, are turned and bored to give the necessary working clearance. The flanges of the channels are made so thin that, although amply sufficient for stiffness, the ring does not have the disadvantage of a solid shroud which acquires a dangerous temperature by friction in case of an accidental contact of the rotating and stationary parts. It is claimed for this construction that the blades are stiffened against the effect of vibration in a much more substantial manner than by any other means thus far employed, while the use of a protecting shroud ring enables the working clearance to be made smaller than in the case of naked blade tips, without danger in case of accidental contact, thus reducing the leakage loss to a minimum, the leakage past the blade tips being the principal source of loss in the steam turbine. As to the safety from damage in case of accidental contact, it is claimed that this has been proven by experiment with actual blading, by throwing the bearings out of center so as to produce contact, without detrimental results. An incidental advantage

claimed for this construction is that if by chance a blade should prove defective, it is so held in place by the shroud ring that it cannot possibly work loose and produce damage.

By the method of construction described, the entire blading is produced by machinery, thus eliminating the personal equation which enters into blading done by hand work and which depends upon the skill of the individual workmen. Besides ensuring that every blade is securely fastened, all blades are necessarily set at exactly the designed angle and pitch, the openings between blades, upon which in great part the economical performance depends, being absolutely uniform. The blading is made up in half rings in the blading shop and is carefully inspected before being inserted in the turbine.

Fig. 1, which was photographed from a drawing, shows the general scheme of the blading, illustrating the method of fastening the blades as well as the channel shaped shroud ring. Fig. 4 is from a photograph of blading, showing the substantiality

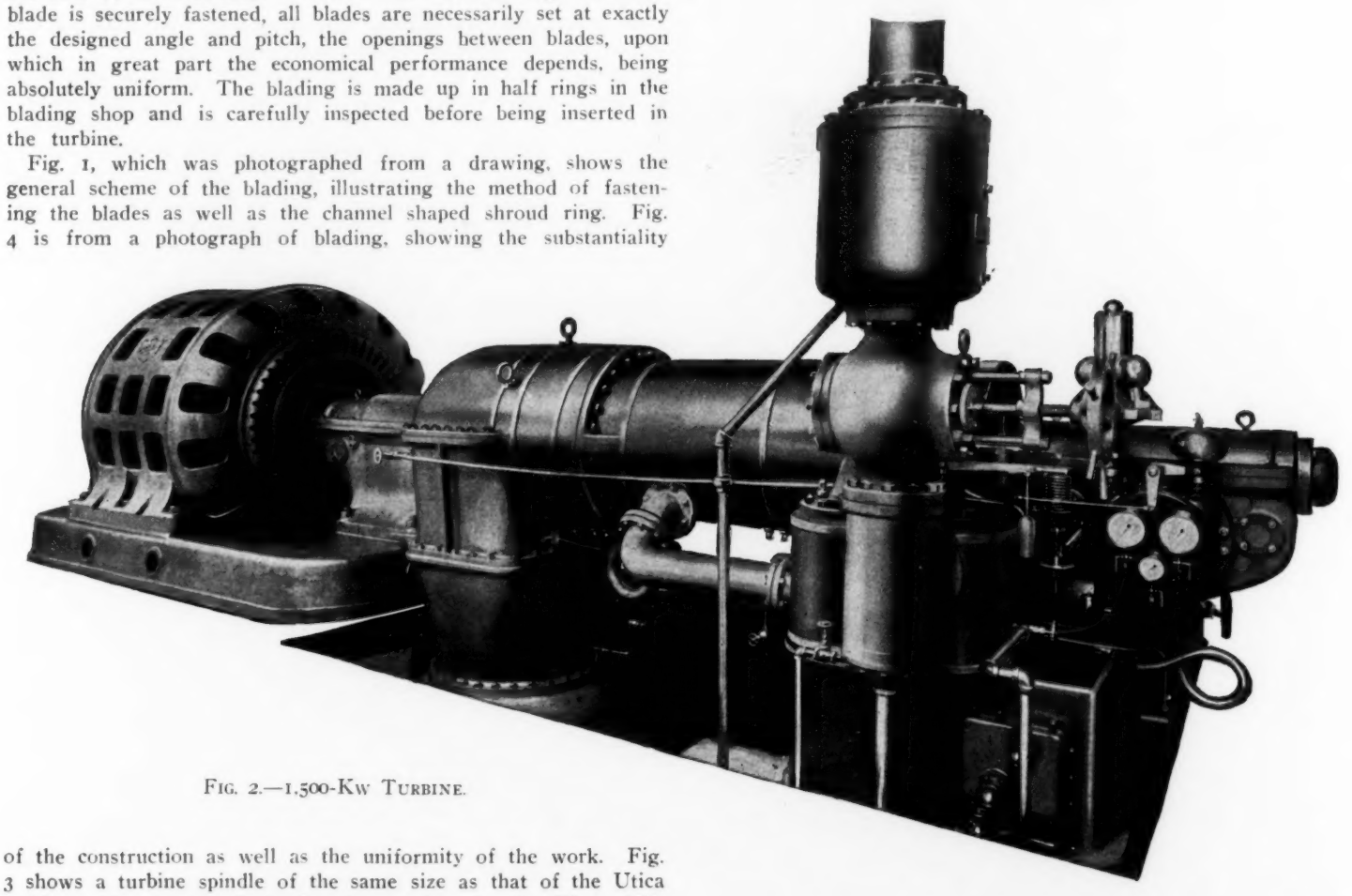


FIG. 2.—1,500-KW TURBINE.

of the construction as well as the uniformity of the work. Fig. 3 shows a turbine spindle of the same size as that of the Utica turbine, this photograph having been taken in the West Allis shops of the Allis-Chalmers Company.

Another special feature of this turbine will be noticed by referring to Fig. 3, viz., the absence of the usual low-pressure "balance piston," thus avoiding the difficulty of producing a balance piston of the size required for balancing the low-pressure stage of the turbine and at the same time make it sufficiently rigid to run with the necessary small working clearance. In the Allis-Chalmers construction there is, however, a third balance piston, but instead of being at the high pressure end of the turbine, as formerly arranged, it is at the low-pressure end, and as it is smaller than the large end of the spindle it is hidden from sight in the photograph. By making this piston in such a way that its circular area is equal to the annular area of the piston used in the older construction, the low-pressure balance piston is made much smaller. Instead of reducing the leakage past this piston by means of "dummy packing," as in the high-pressure and intermediate pistons, and as used in the low-pressure pistons of the older construction, a labyrinth packing of radial baffling type has been adopted, thus eliminating small axial clearance in this turbine. A considerable advantage is claimed for this construction in permitting of the use of smaller working clearances in the high-pressure and intermediate balance pistons.

There are a number of other points of improvement claimed for the Allis-Chalmers construction which will not permit of description within the space of the present article. These include details of spindle construction, governing mechanism, lubrication and other minor features.

The alternating-current generator of the Utica outfit also is

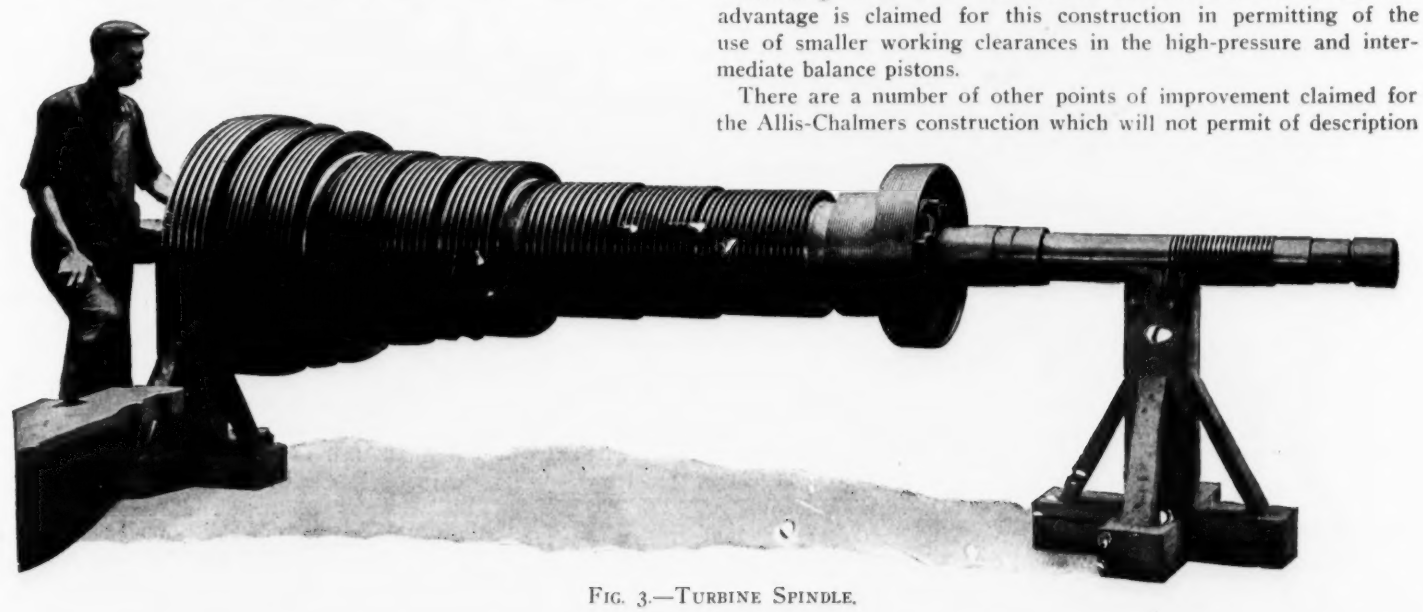


FIG. 3.—TURBINE SPINDLE.

deserving of more description than the present article will allow. Perhaps the most noticeable feature of this generator is the substantial design of the revolving field, providing great strength and at the same time giving the thorough ventilation which is essential. Particular attention has been paid to the insulation, as may be inferred from the fact that the armature was subjected to an alternating-current insulation test of 10,000 volts for the period of fifteen minutes. This generator was built at the Bullock Works of the Allis-Chalmers Company at Cincinnati, where the generators for all of their other turbine outfits are being built.

The Allis-Chalmers Company, in entering the steam turbine field, effected an alliance with the Turbine Advisory Syndicate of England, thereby securing the co-operation of the firms therein interested, including Messrs. Willans & Robinson, the famous high-speed engine builders, of Rugby; Yarrow & Company, the well known torpedo boat builders, of the Isle of Dogs, London; and the Neptune Shipbuilding Works, Walker-on-Tyne. The Utica turbine, in fact, was built for the Allis-Chalmers Company by Messrs. Willans & Robinson, to whom a number of turbine contracts were sublet by the Allis-Chalmers Company before the latter had perfected the installation of its special machinery for turbine manufacture. An agreement has more recently been effected with Hon. Charles A. Parsons, C.B., for interchange of data, thereby giving to the Allis-Chalmers Company the benefit of the vast experience of Mr. Parsons, the original inventor of this type of turbine, and to whose engineering ability and indomitable energy the evolution and present state of perfection of the successful steam turbine are principally due. The Allis-Chalmers Company has also secured rights under Mr. Parsons' patents for marine turbines and turbo-compressors and blowers, for which there is a growing demand.

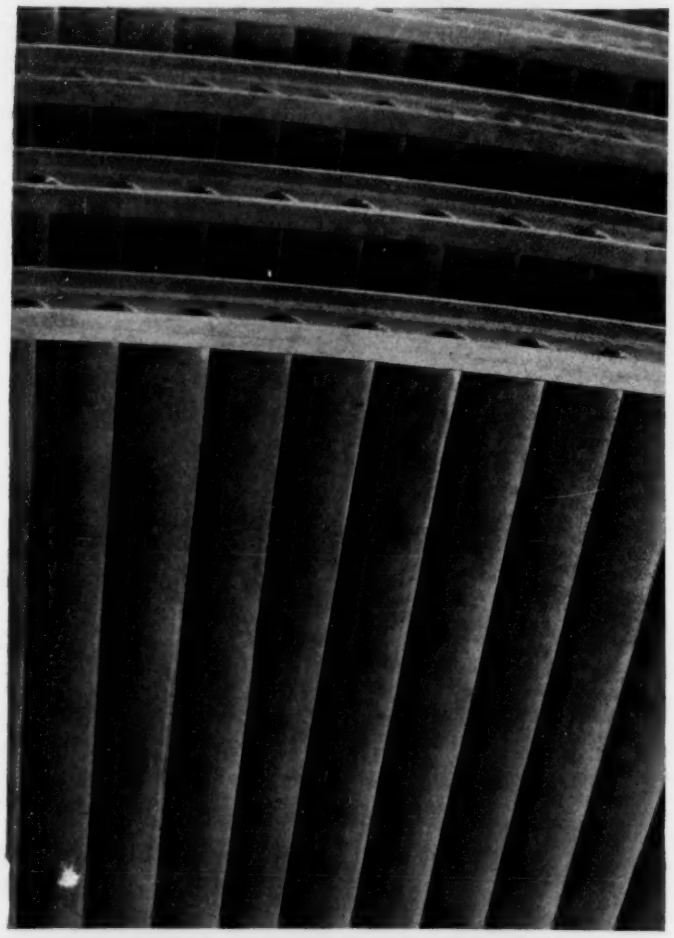


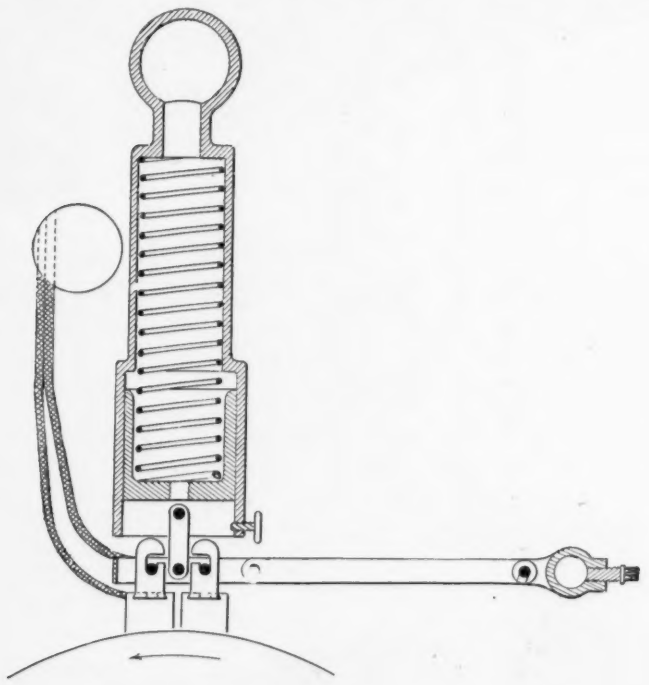
FIG. 4.—SECTION OF BLADING.

At present the Allis-Chalmers Company is building its steam turbines in its engine works at West Allis. The growth of the business, however, has led to a large extension of the works, amounting to a practical doubling of the present plant. A considerable part of the extension will be devoted to the manufacture of steam turbines and the accompanying electric generators, one of the three new manufacturing buildings being given up to the exclusive manufacture of the turbines themselves. The first steam turbine of the Allis-Chalmers Company's own make, of 5,500-kw capacity, has recently been shipped, and others are following as fast as the present crowded condition of the shops will permit.

Pneumatic Brush Holders for Turbo-Generators.

One of the most difficult problems connected with the design of direct-current generators for abnormally high speeds resides in the selection of material and arrangement of parts of the brushes and brush holders. It is essential that the pressure exerted by the brush mechanism be sufficient to cause the brush to remain always in contact with the commutator, and yet an excessive pressure entails a considerable frictional loss at the high peripheral speed of the commutator. The problem is rendered yet more difficult if the surface of the commutator is irregular, for in this case the mass of the moving members of the brush mechanism must be kept at a low value in order that its inertia may speedily be overcome without the application of an abnormal force.

The accompanying illustration shows a recent design for brush holders, including the advantageous features of a minimum mass of moving parts and uniform pressure to all brushes independent of their number. The flexible leads are embedded in the brush during the process of manufacture. The brush is mechanically connected through links to a light piston in a cylinder into which air is admitted under a pressure of about five pounds per square inch. Owing to the small value of the inertia the brush responds rapidly to any slight irregularity of the surface of the commutator, thus insuring good contact at all times with a minimum of friction. Each brush is made in two parts, which are so interconnected mechanically that each part may move independently of the other, which construction affords an additional assurance that a proper area of contact will always be maintained with the commutator.



PNEUMATIC BRUSH HOLDER.

By the employment of compressed air absolutely uniform pressure is assured for all of the brushes, a condition which is difficult to obtain when the pressure of each brush is regulated independently. In practical operation the air under pressure is supplied from a compressor run in connection with the oil pump. Each brush is built up of laminæ of graphite, which have been subjected to enormous mechanical pressure between their faces. It is claimed that the unsymmetrical arrangement of the molecules which thus results causes the specific electrical resistance to be much greater in line with the pressure than in mechanical quadrature therewith. The

advantageous features claimed for this brush are as follows: Extremely high conductivity along the brush, considerable transverse resistance, comparatively high contact resistance and unique lubricating qualities. It is stated that large generators, which sparked at half load with carbon brushes, are now running satisfactorily at full load with these special graphite brushes, and that owing to the electrical properties above noted the total increase in efficiency in special cases has been as much as 5 per cent, and is generally from 2 to 3 per cent, by the mere substitution of these brushes for ones made of the ordinary carbon.

The pneumatic brush holder for turbo-generators and the "Morganite" graphite brushes for both direct and alternating-current commutation are manufactured at the Battersea Works of the Morgan Crucible Company, Limited, London, England.

Electric Pipe Thawing Apparatus.

The Westinghouse Electric & Manufacturing Company has placed on the market two pipe-thawing outfits, one for heavy service, comprising a specially designed choke coil used in connection with the

THAWING OUTFIT.

primaries of a standard transformer, and another for lighter service, consisting of a transformer adapted for suitable secondary voltage adjustments mounted in the cast-iron top and bottom frames. The heavy-duty outfit consists of a choke coil connected in series with the primary of a standard 2,200-volt, 60-cycle transformer of from 15 to 25 kw capacity. The coil is compactly built and enclosed in a cast-iron case with a base 16 by 16 in. Five plug receptacles mounted in the upper portion of the case provide a simple means of varying the primary voltage. The various taps give approximately 50, 60, 75, 87 and 95 per cent of the full-line voltage. By changing the position of the plugs any one of these combinations may be used.

The smaller outfit is intended for lighter service, such as thawing house piping. It is compactly built and enclosed in a case with cast-iron top and bottom, the transformer laminations themselves being exposed to the air, thus providing excellent conditions for cooling. Handles are provided on the top casting which will enable one man in an emergency to carry the transformer, as its weight complete is approximately 100 pounds. It is intended for use on 2,200-volt, 60-cycle circuits. The variation in secondary voltage is from 55 to 35 and a current of 100 amp. can be maintained for one-half hour without undue heating. No oil is used with this transformer, as the insulation is specially prepared to withstand severe conditions.

In operation the transformer should be placed as near the pipes to be thawed as possible. For dwellings one low-tension lead may be connected to a house faucet and the other to a hydrant beyond the frozen section. For thawing street mains two hydrants may be conveniently used. On account of the different conditions met with it is impossible to prescribe the exact voltage or current necessary to do any particular thawing. In general the voltage necessary to force the same amount of current over pipes of the same diameter will vary with the length of pipe. Large pipes require less voltage to force the same current through a given length, but require more current to thaw them out.

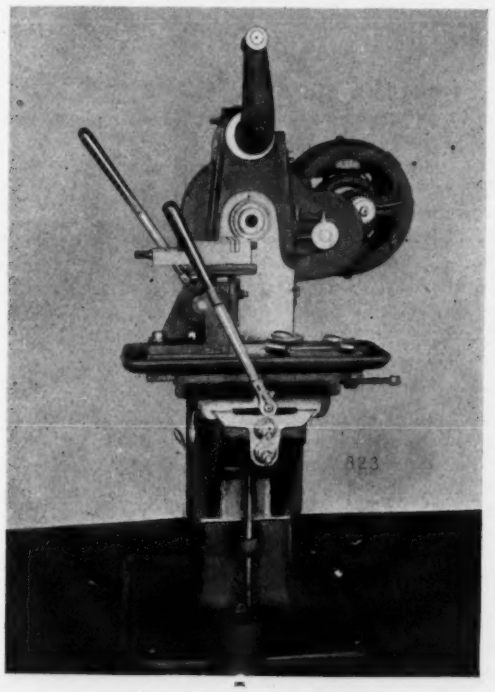
For pipes up to 5 in. in diameter approximately 500 amp. is usually sufficient, while 12-in. mains may require 1,000 amp. As a rule, a small current for a long period of time will do the work of a large current applied a shorter time, and the thawing will be done with less chance of injury to the piping system.

1,000-HP Induction Motor in a Paper Mill.

An interesting installation of induction motors has recently been completed at Massena, N. Y., taking power from the generating station of the St. Lawrence River Power Company. This company furnishes electricity for the operation of various industries, including the manufacture of paper from wood pulp. It is in this class of work that the induction motor has been found most suitable and an example is to be found in the plant of the Remington-Martin Paper Company. In this mill the pulp grinders are direct-connected to an induction motor of 1,000 hp, which operates at 2,080 volts, 25 cycles, three-phase, at 214 r.p.m. This motor, which was made by the General Electric Company, drives four wood pulp grinders, two being connected at each end of its shaft. It is started with an external resistance connected through collector rings to the rotor. The grinding of pulp with electric power has been found so satisfactory that the company is about to adopt it in another mill.

Motor-Driven Hand Miller.

For milling machines, not back-geared, a simple and compact form of motor drive is shown in the illustration of a hand milling machine, built by the Garvin Machine Co., New York. A variable-speed motor having a range of four to one is used, and is geared to the spindle, through an intermediate gear shaft. A bronze pinion is used on the motor, and all the gears are totally enclosed, and run very smoothly,



MOTOR-DRIVEN MILLING MACHINE.

without noise. With this arrangement, the spindle has a range of speeds from 60 to 240.

The head on the table carries a vertical slide, having a movement of 1⅝ in. by lever and pinion, on which the vise is mounted, and the table itself has a horizontal movement of 7 in. by level, through rack and pinion. Both slides are fitted with stops, and may be operated simultaneously. These machines are particularly economical in manufacturing operations, requiring short cuts. The weight is 1,300 pounds.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Trade broadens in a healthy manner in response to lower temperatures and holiday demands. Business in holiday goods promises to add another high-level record to this record-breaking year, but retail trade in seasonable goods fluctuates in volume due to the irregularities of the weather. The approach of the stock-taking period brings with it quieting tendencies in wholesale trade. Activity still prevails in the industries, iron and steel and building being notable instances. New business is not coming forward so freely, but the demand for many products is so far ahead of the supply that there is little interest in current operations. The leading steel producer announces that contracts average about 50,000 tons daily, which is 15,000 tons in excess of capacity. Activity is still a feature in textile trades. The recent advance in cotton and the talk of 15 cents for the balance of the crop are disturbing elements in future business. Railway business continues remarkably heavy, gross receipts for November promising an increase of about 9 per cent over last year. Holding of cotton at the South and of grain at the West, coupled with the car congestion, retard collections. The prices for staples show unsurpassed strength, and there is an unprecedented demand. The market for metals, other than iron and steel, is higher. Copper advanced ¼c.; Lake and electrolytic closing at 18c. and casting stock at 17⅞c. *Bradstreet's* reports 203 business failures during the week ending December 7, as against 188 the preceding week and 231 the corresponding week last year.

TRADE IN MANUFACTURES.—The manufacturers of the country continue to increase their share in both the imports and the exports of the United States. In the 10 months ending with October, 1905, their importations of materials for use in manufacturing formed 47.8 per cent of the imports of the country, against 45.8 per cent. in the corresponding period of last year, and their exports of manufactures formed 38.2 per cent of the total domestic exportations, against 36.7 per cent in the corresponding months of 1904. Manufacturers' materials show a greater increase in the imports than all the other classes of imports combined, and manufactures show a greater gain in exports than all the other classes combined. The increase in the importation of manufacturers' materials in the 10 months ending with October, 1905, amounts to $81,000,000, an increase of 21 per cent over the corresponding months of last year, while the increase in all other imports amounts to but $54,000,000, an increase of 12 per cent over the corresponding months of last year. In exports the increase of manufactures is $58,000,000, or 14 per cent, while the gain of all other exports is but $49,000,000, an increase of 7 per cent over the corresponding months of 1904. On the export side the largest increases are in cotton cloths, copper, manufactures of iron and steel and leather and its manufactures. The exports of copper were $72,000,000 in value, against a little less than $61,000,000 in the corresponding months of last year; iron and steel, $115,000,000, against $105,000,000 in the same months of last year, and leather, $32,500,000, against $28,750,000 in the same months of last year.

BIDS FOR NAVY SUPPLIES.—Bids will be received until December 26 at the Bureau of Supplies and Accounts, Navy Department, Washington, to furnish at the navy yards at Portsmouth, N. H.; Boston, Mass.; Newport, R. I.; New York, N. Y.; League Island, Pa.; Washington, D. C., and Norfolk, Va., motor-generator sets, conduit and fittings, electrical supplies; also on January 9 to furnish at the navy yards at Mare Island, Cal., and Puget Sound, Wash., motors, cable, circuit-breakers, electrical supplies, electric hoist and runway, electric motor-driven outfit. H. T. B. Harris, Paymaster-General, U. S. N. Bids will be received until Dec. ,19 at the Bureau of Supplies and Accounts, Navy Department, Washington, to furnish at the navy yards at Portsmouth, N. H.; Boston, Mass.; Newport, R. I.; New York, N. Y.; League Island, Pa.; Annapolis, Md.; Washington, D. C., and Norfolk, Va., rubber and lead-covered wire, iron conduit and fittings, switches, electrical supplies and motor-generator set. H. T. B. Harris, paymaster-general U. S. N.

THE PELTON WATER WHEEL COMPANY has been awarded a contract for another impulse wheel by the Vancouver Power Company, of Vancouver, B. C. A generating set will be installed consisting of a 3,000-hp Pelton unit of the "double-overhung" type, direct-connected to a 1,500-kw, three-phase, 2-r.p.m. generator, operating at a head of 390 ft. Similar units have been installed with Pelton wheels and the power house is arranged for the reception of two additional units providing for a total overload capacity of 15,000 hp. The Eastern works of the Pelton Company will construct the additional pressure pipe line comprising about 1,050 ft. of pipe, varying from 48 in. in diameter and 9/32 in. thickness to 42 in. diameter and 17/32 in. thickness. The contract calls for the material delivered installed. The Columbus Consolidated Mining Company, of Utah, has duplicated its order for a 750-hp Pelton water wheel, the original of which was filled two years ago, while the United Light & Power Company, of Georgetown, Cal., is installing an additional 1,000-hp Pelton unit, this being the second order received from that company within three years.

INDUSTRIAL ADVERTISING MANAGERS DINE.—The Technical Publicity Association, whose members are the advertising managers of the machinery and electrical manufacturers east of Ohio, dined and held an open meeting at the Aldine Association, 111 Fifth Avenue, Friday, December 8, 1905. Mr. Geo. H. Gibson, a former secretary of the association, made an address on "Lost Motion in Machinery Advertising," which was followed by an informal discussion. Among the concerns represented at the dinner were the Ingersoll-Rand Drill Co., New York; Niles-Bement-Pond Co., of New York; General Electric Co., Schenectady, N. Y.; Crocker-Wheeler Company, Ampere, N. J.; Sprague Electric Company, New York; De La Vergne Mechine Co., New York; John A. Roebling's Sons Co., Trenton, N. J.; M. H. Treadwell Co., New York; the Westinghouse Companies, Pittsburg, Pa.; New York Edison Co.; Yale & Towne Manufacturing Co., New York; American Wood Working Machinery Co., New York; B. F. Sturtevant Co., Boston, Mass.; H. W. Johns-Manville Co., New York; Holophane Glass Co.; Sawyer-Man Electric Co., New York.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY is doing a large business in equipping mines with electric locomotives. A recent contract closed by the Westinghouse Company is one with the Newport Mining Company, which has decided to equip its mines at Ironton, Mich., with both surface and underground electric haulage. It will use electric locomotives the year around in the various levels underground for bringing the ore to the bottom of the shaft, and after the transportation season has closed will use electric locomotives on the surface for hauling ore from the top of the shaft to the various stock piles for storage. For these purposes it has ordered 6 four-ton Westinghouse mine locomotives. Electrical apparatus for the equipment of the necessary power station will also be provided by the Westinghouse Company, consisting of a 150-kw, 250-volt generator, direct-connected to a Corliss engine of 130 r.p.m., and a three-panel switchboard, besides other auxiliary apparatus.

CONSOLIDATED POWER PLANTS.—The Consolidated Railway Company, the holding corporation for the street railways and interurban electric lines controlled by the New York, New Haven & Hartford Railroad Company, is considering a plan to centralize the electrical generating plants for the four divisions in southeastern Connecticut, comprising the Norwich & Willimantic, the Norwich Street Railway, the Montville Street Railway and the New London Street Railway systems, by doing away with the four separate power stations and substituting for them one big central generating station at Thamesville. The proposition will not do away entirely with the local power stations, but will convert them into sub-stations. Electrical Engineer Gaillard has been investigating the several plants of the four systems for the purpose of figuring on the cost of the central power station.

THE NORTHERN ENGINEERING WORKS, crane builders, of Detroit, Mich., have been awarded the contract for the electric cranes required in the new steel casting foundry of the Monarch Coupler Company, Limited, of Detroit, Mich. There will be one 25-ton, 4-motor electric ladle crane, 50-ft. span, one 10-ton, 4-motor standard crane, 50-ft. span. The Northern Engineering Works have also recently completed installing three electric traveling cranes in the plant of the Detroit Steel Casting Company, consisting of one 30-ton, 4-motor ladle crane and two 10-ton, 3-motor electric cranes, 70-ft. span, and are now constructing for the same firm a 10-ton, 80-ft. electric gantry for yard service.

TAYLOR'S FALLS POWER.—The plan for transmitting 50,000-volt current from the power house at Taylor's Falls to the city of Minneapolis, Minn., embraces a distance of 41 miles, for which a 60-ft. right of way has been purchased. Oregon cedar poles will be used, but in some sections, on unusually heavy strain, steel towers will be substituted. The porcelain insulators each weigh 22 pounds. Power will be generated as three-phase currents at a pressure of 2,300 volts. The line at present under construction will have a capacity of 25,000 hp, which will be used in Minneapolis.

STURTEVANT ORDERS.—Among recent contracts for heating and ventilating equipment placed with the B. F. Sturtevant Co., Boston, Mass., are included those for the National Tube Co., McKeesport, Pa., for rolling mills and machine shop, containing over 1,000,000 cu. ft. of space; for the Fairbanks-Morse-Canadian Mfg. Co., Toronto, Ont., including separate apparatus for machine shop, blacksmith shop and foundry; for Brown & Sharpe Mfg. Co., Providence, R. I., for Pressed Steel Car Co., McKees Rocks, Pa., for car paint shop containing nearly 4,000,000 cu. ft. of space; and for a similar shop containing over 2,500,000 cu. ft. at the Allegheny, Pa., plant of the same company. The new office building for the Studebaker Bros. Mfg. Co., South Bend, Ind., is to be heated and ventilated by a fan system. Orders for generating sets have recently been placed with B. F. Sturtevant Co., Boston, Mass., by W. D. Byron & Sons, Monroesburg, Pa.; Chas. E. King, Brooklyn, N. Y., and Old Colony Street Railroad Company, Quincy Point, Mass. Mechanical draft apparatus is to be installed by Appleton Woolen Mills, Reedsburg, Wis.; Lancaster Cotton Mills, Lancaster, S. C.; Lukens Iron & Steel Company, Coatesville, Pa., and Arnold Print Works, North Adams, Mass. The well-known soap manufacturers, James T. & W. S. Pyle, Edgewater, Bergen County, N. J., are installing in their boiler plant complete induced draft equipment furnished by the B. F. Sturtevant Co.

WESTINGHOUSE ORDERS.—The Westinghouse Electric & Manufacturing Company has recently shipped a 1,200-kw generator to the Hawaiian Electric Company, of Honolulu, making the second order of this kind placed by the same company. Another order recently received was from the Los Angeles Light & Power Company for a 7,500-kw machine. A duplicate of this order was also received from the Rapid Transit Development Company, of Brooklyn, which acts as the purchasing agent for the Brooklyn Rapid Transit Company. The Westinghouse Company has received orders for turbines running between 10,000 and 12.000 hp from the Brooklyn Rapid Transit, the Interborough Company, the Philadelphia Transit Company, the New York Edison Company and the Los Angeles Light & Power Company. The Missouri River Power Transmission Company, whose plant is located near Helena, Mont., has begun the erection of a steam turbine power plant to operate as a reserve to its water power plant. A large part of the output of the Missouri River Company is transmitted to the city of Butte and to the Anaconda district mining properties, and the erection of this reserve plant is to guard against serious fluctuations in the available water power. Two Parsons turbines of 2,000 kw capacity each will be installed. During October the Westinghouse Electric plant at East Pittsburg shipped various kinds of electrical apparatus with a total weight of 17,000,000 pounds, consisting of 5,000 individual consignments.

THE R. M. PATRICK COMPANY has been incorporated in Chicago with a capital stock of $35,000, to carry on several departments of work. One department is to be devoted to contracting, electrical and hydraulic engineering. Mr. R. M. Patrick, the head of the company, has been prominently connected with several Canadian hydro-electric developments. The company is also prepared to act as consulting engineers, making reports, surveys and estimates on all kinds of engineering work. It will have a corps of experienced engineers in all lines. Another department of the company is prepared to finance new properties or buy and sell and improve properties already in existence. The three departments will be conducted independently. The company announces that it is prepared to undertake contracts of any magnitude, having ample financial resources to carry out any contract that may be offered. A suite of offices is now being fitted up in the First National Bank Building, Chicago.

AUTOMOBILE SHOW.—When the sixth annual show of the Automobile Club of America is opened on Saturday night, January 13, the public will have its first view of the fine new armory of the Sixty-ninth Regiment, the most convenient entrance of which will be on Twenty-sixth Street near Fourth Avenue, with other entrances on Lexington Avenue and Twenty-fifth Street. The cost of this big structure is placed at $1,500,000, and the spacious exhibition hall possesses what is probably the largest brick arch in the world. With everything new and thoroughly up to date, this huge building will supply a spacious home for the most comprehensive exposition of the automobile industry ever held in this country. Gasoline, steam and electric vehicles, both for pleasure and business purposes, will be attractively distributed, with space left for all sorts of accessories and sundries; in fact, everything connected with the industry will be given a place in the extensive show.

C. W. LEE COMPANY, Scheuer Building, Newark, N. J., has been formed to handle and prepare advertising and publicity matter for the various electric light and power companies throughout the country. The new concern has secured the advertising contract of the Public Service Corporation of New Jersey, covering all the departments of electricity, gas and street car lines. Mr. Lee has already made quite a reputation by his work on behalf of this great company and thus has a splendid basis for a similar campaign elsewhere. Mr. Lee is vice-president and manager of the concern and the secretary is Mr. Frank B. Rae, Jr., the publisher of *More Juice* and *Electric Service*. The business of Ried & Rae Co., Inc., of Detroit, has been purchased and the new combination has at once become an important factor in the electric and gas commercial fields.

THE PENNSYLVANIA RAILROAD COMPANY has given this week to the General Electric Company a contract for the electrification of one of its lines from Philadelphia to Atlantic City, involving an expenditure of from $2,000,000 to $3,000,000. As a railroad project it is in more ways than one unique, and is the first contract of its kind, so far as is known. It means the scrapping of the entire equipment of the line involved, or at least the transferring of the succeeded steam equipment to other divisions. About 60 miles of line in all are to be converted to electricity. Included in the contract is the power station with Curtis turbines. Cars are to be equipped with the Sprague-General Electric multiple-unit control, and are to be run on a 15-minute service just as are the trains in the subway and on the elevated. Work on the enterprise will begin immediately.

THE LIVE STOCK PAVILION erected recently at the Union Stock Yards, Chicago, has a seating capacity for 7,000 people. The main arches are 200 ft. from center to center of bases approximately and 1,000 tons of steel were required in its construction. The structural work was furnished by the Modern Steel Structural Company, of Waukesha, Wis. The same company has just completed the erection of a steel coal-handling bridge for the Robins Conveying Belt Company, of New York, built for the Semet-Solvay Company at its Milwaukee coke plant. The bridge, which is one of the largest structures of its kind in the world, is supported by a pivotal tower, and swings around on a stiff leg in a half circle. The distance between tower and leg is 360 ft. The length of the bridge, including cantilevers, is 500 ft.

THE COPPER POSITION.—Copper went to 18 cents the past week and is in a strong position. The movement for the first few days of December indicates that the exports this month will probably considerably exceed those of November. For the first week of this month the exports have amounted to over 4,500 tons, compared with a total of about 12,400 tons for the entire month of November. The record of copper exports for the past few years shows in general a steady increase. It was in January, 1904, that the maximum was reached, but many of the months this year have exceeded the figures for the corresponding months last year. From present indications the total exports of copper this year will almost equal those for the previous twelve months, during which 247,421 tons were exported.

TALLAPOOSA ELECTRIC PLANT.—Bids will be received until Jan. 2 by Mayor G. W. Shepperd and Council, Tallapoosa, Ga., for machinery and material and installing complete an electric light plant. The proposed plant embraces one 66-in. x 18-ft. high pressure boiler and stack, one 100-kw alternating current unit. Bids will be received on generator belted to Corliss engine, and also on generator direct-connected to automatic engine, 6 arcs and 74 50-cp series incandescents, 1,000-light transformer and meter capacity, and poles line. Address J. B. McCray, engineer, Senoia, Ga.

POWER DEVELOPMENT IN OREGON.—The Cascade Power Company, Portland, Ore., announces its intention of utilizing the headwaters of the Sandy River at a point 14 miles above the Bull Run pipe-line bridge, and establishing there a plant of sufficient power to generate 25,000 horse-power. It is expected that work will begin at once and power be delivered to the city by August, 1906. E. R. Richardson and A. C. Churchill & Co. are interested in the enterprise. B. Chase and H. I. Neville are engineers.

CONSTRUCTION CONTRACT.—The Wernersville Electric Light, Heat & Power Company has awarded the contract for the apparatus for its power station at Wernersville to the Brown Engineering Company, of Reading, Pa. The General Electric apparatus will be used, and a three-phase system for power and light will be installed. George W. Wertz, president of the company, advises that the plant will be pushed to completion at an early date and will be in a position to supply current in a short time.

STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., reports having closed contracts for switchboards for the following places: Fulton, Kan.; Jamestown, N. Y.; Spanish Fork, Utah, Tonopah, Nev.; Leechburg, Pa.; Whiting, Ind.; Tingley, Iowa; Herrick, Ill.; La Grange, Ky.; Streator, Ill.; Seattle, Wash., and Germantown, Neb.

MILWAUKEE BONDS.—Spencer Trask & Co. and N. W. Harris & Co. announce their joint purchase of $2,000,000 refunding and extension mortgage 4½ per cent gold bonds of the Milwaukee Electric Railway & Light Company.

Financial Intelligence.

THE WEEK IN WALL STREET.—Stock speculation was active and strong in tone under manipulation, despite the highest money rates of the year, industrial stocks being particularly prominent. Railroad stocks, while relatively quiet, were firm. The disposition of the market was to disregard unfavorable factors and to discount the beneficial effects of the present situation upon railroad and industrial properties. More or less weight is attached to the position taken by the President in his message of opposition to tariff changes, which was used as an argument in favor of bullishness regarding the securities of steel and iron corporations. There also seemed to be a disposition to consider that Congress is unlikely to take action in relation to the so-called trust problem, which would adversely influence the industrial stocks, and the latter, accordingly, were more prominent than were the railroad securities. Amalgamated Copper advanced to 98, on the copper trade situation. The United States Steel stocks, however, remained quiet, despite further intimations that earnings for the current quarter are highly satisfactory. There was considerable activity in Allis-Chalmers common, 86,500 shares having been sold at prices ranging between 19½, the lowest, and 24¼, the highest. The closing quotation was 23¼, which is a net gain of 3¾ points. Preferred reached 66¼ and closed at 65¼, this being an advance of 3¼ points. General Electric was quiet and closed at 184½, a net gain of ½ point. Westinghouse was weak and comparatively neglected, closing at 173, which is a net loss of 1⅛ points. American Locomotive had a downward tendency. Common ranged between 69 and 73, and closed at 69¾, this being a decline of 1¼. Preferred closed at 117. Tractions were weak and on the decline. Brooklyn Rapid Transit closed at 85 and Metropolitan Street Railway at 118½, the latter being a net loss of ¼ point. Interborough Rapid Transit advanced 1 point, closing at 211. The telegraph list was featureless. American Telephone & Telegraph closed at 133¾, a net decline of 4¾, and Western Union at 92¼, which represents a gain of ⅜ point. Mackay Companies declined 1⅛ points, closing at 50¾. The curb market was agitated by the pools, with much manipulation of the low-priced copper shares. Changes in other stocks were mixed. Following are the closing quotations of December 12:

NEW YORK

	Dec. 5	Dec. 12		Dec. 5	Dec. 12
Allis-Chalmers Co	22¾	22	General Electric	185⅛	183
Allis-Chalmers Co. pfd	64	62	Hudson River Tel	...	...
American Dist. Tel	37	37	Interborough Rap. Tran	211	208
American Locomotive	72⅜	70	Mackay Cos.	50¼	50¾
American Locomotive pfd	118	116⅛	Mackay Cos. pfd	71	72
American Tel. & Cable	90	89	Marconi Tel	...	...
American Tel. & Tel.	132	133	Metropolitan St. Ry	117¾	118⅛
Brooklyn Rapid Transit	85	86	N. Y. & N. J. Tel	...	...
Electric Boat	32	25	Western Union Tel	92¼	93
Electric Boat pfd	70	65	Westinghouse com	170	171
Electric Vehicle	14	12	Westinghouse pfd	..	..
Electric Vehicle pfd	20	17			

BOSTON

	Dec. 5	Dec. 12		Dec. 5	Dec. 1
American Tel. & Tel	132⅞	135	Mass. Elec. Ry. pfd	59½	60
Cumberland Telephone	...	...	Mexican Telephone	1⅛	1⅛
Edison Elec. Illum	...	239	New England Telephone	..	132
General Electric	...	...	Western Tel. & Tel	12	..
Mass. Elec. Ry	...	...	Western Tel. & Tel. pfd	..	..

PHILADELPHIA

	Dec. 5	Dec. 12		Dec. 5	Dec. 12
American Railways	52	52¼	Phila. Electric	9⅜	8⅝
Elec. Co. of America	11¼	11⅜	Phila. Rapid Trans	31¾	32¾
Elec. Storage Battery	80⅛	82	Phila. Traction	..	100¾
Elec. Storage Battery pfd	..	..			

CHICAGO

	Dec. 5	Dec. 12		Dec. 5	Dec. 12
Chicago City Ry	200	200	National Carbon	76½	75
Chicago Edison	161	...	National Carbon pfd	*120	117
Chicago Subway	53	...	Union Traction	..	..
Chicago Tel. Co	137	...	Union Traction pfd	..	..
Metropolitan Elev. com	27	28⅛			

* Asked.

DIVIDENDS.—Interborough Rapid Transit Company's directors have declared the regular 2 per cent quarterly dividend, payable January 2, to the holders of the voting trust certificates of record December 11. The directors of the Mackay Companies have declared the regular dividends on the common and preferred stock. The common is 1 per cent semi-annually and the preferred is 1 per cent quarterly. The United Railways Investment Company, of San Francisco, has declared its full semi-annual dividend of 2½ per cent. For the first half of this year the dividend was 2 per cent. The back dividend on the preferred stock amounts to $900,000. Arrangements are now under way to have these arrears paid by some sort of funding operation. The United Railroads of San Francisco have declared the regular half yearly dividend of 2 per cent on the preferred stock. J. G. White Co., Inc., has declared its eleventh regular quarterly dividend of 1½ per cent on the preferred stock, payable January 1, 1906. A regular semi-annual dividend of $5 has been declared on West Philadelphia Passenger Railway Company, payable January 2. A regular semi-annual dividend of $4.75 has been declared on Union Passenger Railway Company, payable January 2. The directors of the Twin City Rapid Transit have declared the regular quarterly dividend of 1¾ per cent on the preferred stock, payable January 2. Directors of the Otis Elevator Company have declared the regular quarterly dividend of 1½ per cent on the preferred stock. The executive committee of Western Union has recommended the declaration of the regular quarterly dividend of 1¼ per cent. The Chicago Telephone Company has declared the regular quarterly dividend of 2½ per cent, payable December 30. The Strowger Automatic Telephone Company has declared a semi-annual dividend of 50 cents, payable January 2.

LEHIGH VALLEY TRACTION COMPANY.—The reorganization committee of the Lehigh Valley Traction Company has notified the preferred and common stockholders that the assessment of $1 per share is payable Jan. 15. It is expected that the securities of the Lehigh Valley Transit Company will be ready for delivery early in the new year. The various properties of the system were turned over to the Lehigh Valley Transit Company on Dec. 1. The reorganization committee has decided to pay, as permitted by the plan, the three defaulted coupons—December, 1904, and June and Dec., 1905—on the $2,770,000 first mortgage 4's of the Lehigh Valley Traction Company; also to pay off the loan secured by deposit of the remaining $230,000 of the authorized issue of $3,000,000 of these bonds.

NEW YORK BUILDING.—The valuation of building permits filed in Greater New York from January 1 to November 30, 1905, aggregated $217,953,000, as compared with $129,792,600 in the corresponding period of last year. In no previous year has such a large total been reached. The building permits in thirty-two of the principal cities of the country in the month of November aggregated $41,366,000, as compared with $33,517,000 in the corresponding month of last year. Omaha leads the list, showing an increase of 443 per cent. Denver is second with 223 per cent.

PHILADELPHIA BELL.—Advices from Philadelphia state that the Bell Telephone Company, of Philadelphia earnings for the first half of the year are more than sustained in the second half, and 1905 gross should exceed $4,000,000 and net $1,250,000. The indicated net is equal to nearly 8 per cent on the stock, of which $16,000,000 has now been issued. The 1904 gross was $3,756,059 and the net $945,256. The company has now installed in Philadelphia and on its Delaware & Atlantic lines over 120,000 telephones, an increase of over 37,000 since January 1, 1905.

NORTHERN TEXAS ELECTRIC.—Stone & Webster, of Boston, have organized the Northern Texas Electric Company, which owns practically all the stock of the Northern Texas Traction Company. This company operates an electric street railway system in Fort Worth, Texas, and an interurban line from that city to Dallas, a distance of about 30 miles. The earnings of this system are satisfactory and are increasing rapidly. The Northern Texas Electric Company is issuing no bonds, the capitalization consisting of preferred and common stock.

COOPER HEWITT LAMPS FOR GOVERNMENT BUREAU.—The Cooper Hewitt Electric Company has just closed a contract with the Bureau of Engraving and Printing at Washington, for a large number of Cooper Hewitt lamps. After thorough test, the Bureau has found that these lamps are excellently adapted to the work of printing, and it is understood that our currency, as well as internal revenue tobacco stamps, will hereafter be printed under the Cooper Hewitt light.

NEW YORK TROLLEYS.—The Bronx, Yonkers & White Plains Railway Company has been incorporated with the secretary of State of New York to build and operate an electric surface road, eleven miles in length. The capital stock is $110,000, consisting of shares of $100 each. The directors are John H. Matthews, George Matthews, M. H. Wood, C. H. West and others, of New York City.

CONNECTICUT.—The Consolidated Railway of Connecticut, controlled by the New York, New Haven and Hartford, has completed arrangements to take over the Western Massachusetts Street Railway and the Woronoco Street Railway. Holders of the last-named stock may take in exchange Consolidated Company's 4 per cent. bonds at $180. The Woronoco stock goes in at $175.

BOSTON & WORCESTER.—At the annual meeting of the Boston & Worcester Electric Companies, President Shaw reported that for the year ended September 20 the earnings show an increase of $53,882, or over 13 per cent. The property has earned 4 per cent on the preferred shares outstanding, after allowing liberal charges for the taking care of its track, roadway and equipment.

GENERAL ELECTRIC STOCK.—The terms under which the General Electric Company offers its new stock issue of $6,000,000 are one share at $100 for each eight shares standing in the name of the stockholder on the company's books on December 16.

MICHIGAN STATE TELEPHONE.—The Michigan State Telephone Company will spend $2,000,000 in extensions in 1906. Five thousand miles of copper wire will be required. The system has 92,000 telephones, an increase of 30,000 this year.

General News of the Week

The Telephone.

HUNTSVILLE, ALA.—The Inter-County Telephone Company has almost finished its new system of telephones, covering the southeastern portion of Morgan county and connecting the system with Huntsville. The new system, which will probably be ready for operation in two weeks, included ten toll stations and a large number of private houses in Morgan county across the Tennessee river. The Inter-County company was incorporated with a capital stock of $20,000, and its officers are: C. E. Hogeboom, president; Gus May, vice-president; C. D. Hogeboom, secretary. The purpose of the company is to establish a system of telephones covering 60 miles of territory.

CORONA, CAL.—The board of trustees of this place has granted a telephone franchise to A. C. Wood.

BOISE, IDAHO.—The Rocky Mountain Bell Telephone Company has awarded a contact for extensive improvements to its exchange here. A new $30,000 switchboard will be installed.

MOSCOW, IDAHO.—The Interstate Co-operative Telephone Company will soon commence the work of extending its line from this city to Lewiston. The Company is rapidly extending its system both in this state and in Washington.

QUINCY, ILL.—The work of laying the conduits and putting the wires in position for the new Home Telephone Company is being pushed very rapidly.

NEW MILFORD, ILL.—The New Milford Telephone Company has been formed. Capital, $5,000; incorporators: T. W. Evans, F. C. Bell and A. T. Chase.

GALVA, ILL.—A number of Galva citizens have held a meeting for the purpose of organizing a mutual telephone company. A committee was appointed to formulate a plan of organization and report later.

CONNELTON, IND.—The Connelton, Branchville & Eckerly Telephone Company, which obtained a municipal franchise in this city last July has begun the erection of a telephone plant in this place for local and county service.

INDIANAPOLIS, IND.—The interests in control of the Indianapolis Telephone Company on Dec. 1 elected the following as voting trustees for the property: James J. Robinson, James S. Brailey, Jr., Breckenridge Jones, W. F. Nolker, E. C. Stifel, N. H. Bauer and Henry Koehler.

FORT WAYNE, IND.—A telephone merger of great importance is under consideration by the Home Telephone Company and the National Telephone Company, whereby the former proposes to take over the latter at a price not made known. The capital stock of each company is $250,000, and the former has the same amount of bonds as the latter.

INDIANAPOLIS, IND.—Mr. C. E. Stinson, formerly manager of the Toledo Home Telephone property, but now general manager of the Indianapolis Telephone Company and the New Long-Distance Telephone Company, has adopted a plan of retrenchment and has already reduced the running expenses $20,000 a year. Several employes have resigned, including H. C. Goldrich, chief electrician.

CAMBRIDGE CITY, IND.—The Citizens' Telephone Company, of this city, has bought the Hagerstown telephone plant and the two exchanges will be consolidated at once, and when united free service will be extended to 1,600 patrons. The lines cover a strip of territory from Losantville on the north to within a short distance of Connersville on the south, and has direct connection with the entire independent telephone system of the State.

MARION, IND.—The Board of Public Works has granted a franchise to Indianapolis, Muncie, Chicago and Marion capitalists, represented by O. L. Barger, to establish an automatic telephone system in this city. No charge is to be made for the use of any telephone until 1,000 have been placed. The rates are to be $1.50 and $2.50 for residence and business telephones respectively. A tax of 66⅔ cents for each telephone will be paid annually into the city treasury.

NEW CASTLE, IND.—With a view of securing closer relations between independent companies and to arrange for a better interchange of business representatives of telephone companies operating in Richmond, Cambridge City, Sulphur Springs, Springport, Spreeland, Liberty, New Lisbon, Mt. Summit, Hagerstown and New Castle held a meeting in this city on Nov. 25. A. C. Lindermuth, of Richmond, was elected president, and C. A. Phelps, of New Castle, secretary.

WABASH, IND.—The Rochester Telephone Company has just won a curious suit, defining, as the decision does, the limitation of the liability of telephone companies for injuries sustained by freaks of lightning. Mrs. John Flinn sued the company for $10,000, alleging that her husband was killed by a flash of lightning which struck the telephone wire, burned off the wire and allowed the ends to fall across a barbed wire fence, the current following the barbed wire for seventy yards and killed her husband who was leaning against the fence. The court held that the liability of the company was too far fetched and dismissed the suit.

INDIANAPOLIS, IND.—The Indianapolis Telephone Company recently acquired by St. Louis and Toledo people is preparing to ask the new board of public works of this city and the new city administration for modifications and alterations in the franchise contract now existing with a purpose to raise the rates from $24 to $32 a year for residence telephones and from $40 to $54 for business houses. The company bases its request upon the greatly increased proportions reached by the company's business and that in order to float a bond issue of $500,000 to meet expenses of extensive improvements now contemplated the company will ask to have the franchise extended for forty years. The company also asks for relief in part of its tax. The present franchise requires the company to pay the city $6,000 annually and $2 a year for every telephone over 6,000. The latter tax is not required of the Central Union Company, and it is claimed that there is a discrimination. It is already manifest that the people will oppose any change in the present contract relating to the rates.

FULTON, IA.—The telephone line between Fulton and Andrew has been rebuilt.

LAKE MILLS, IA.—The new telephone line to Northwood is expected to be completed and in working order soon.

NEW ORLEANS, LA.—The Home Telephone Company has arranged to begin the work of reconstructing the system of the Eastern Shore Telephone Company, which was absorbed by the Home Company some weeks ago. Cable lines are to be run through the country and exchanges opened at Bay Minette and Fairhope.

JACKSON, MICH.—Announcement is made that the Citizens' Telephone Company has planned to extend its rural lines next summer, and nearly double if possible the number of county telephones now in service.

PONTIAC, MICH.—A contract has been entered into between the Oakland Telephone Company of this city and the Peninsula Telephone Company of Detroit. The latter company expects to control the independent toll line service.

GRAND RAPIDS, MICH.—The Citizens' Telephone Company starts the month of December with 7,007 telephones in the local exchange and with over 100 orders to fill. During the month of November 136 orders for new telephones were taken by the company.

SAVAGE, MINN.—The Star Telephone Company, of Lakeville, is contemplating establishing an exchange in this city.

REDWOOD FALLS, MINN.—The Minnesota Central Telephone Company will at once commence the construction of an additional copper line from Minneapolis to Granite Falls.

MERIDIAN, MISS.—New common-battery boards are being installed by the Cumberland Telephone & Telegraph Company in Meridian, Miss., and Paducah, Ky.

ANACONDA, MONT.—The Anaconda & Big Hole Telephone Company has been incorporated with a capital stock of $5,000.

KANSAS CITY, MO.—The American Telephone & Telegraph Company has 150 workmen engaged in stringing new lines between this city and Chicago direct. Heretofore the only way to reach Chicago was by way of St. Louis or Omaha.

CARTHAGE, MO.—Purchase by the Missouri & Kansas Telephone Company of the lines of the Southwest Telephone Company is reported. The Southwest lines cover all of Lawrence and Berry counties, and parts of Newton, McDonald and Greene counties. Exchanges are located at Pierce City, Mount Vernon, Monett and almost all other towns between Carthage and Springfield.

YERINGTON, NEV.—C. W. Fancher and Thos. Harris, both of San Jose, Cal., are interested in the construction of a power plant to be located in the canyon between the Matthews and Boerlin ranches.

CARSON CITY, NEV.—Articles of incorporation of the Silver Bow Telephone & Telegraph Company, capitalized at $50,000, have been filed with the secretary of state. The principal place of business of the company will be at Tonopah. The incorporators are: W. L. McGonigill, W. J. Wheaton and Raymond D. Frisbie.

HORNELLSVILLE, N. Y.—The New York & Pennsylvania Telephone Company will erect a new building and install a new exchange in this city.

RIVERHEAD, L. I., N. Y.—The directors of the Baiting Hollow & Roanoke Telephone Company have voted to ask the stockholders to authorize an increase of capital stock from $20,000 to $50,000 for the purpose of extending the company's service.

ROCHESTER, N. Y.—The stockholders of the Rochester Telephone Company have received circulars from the United States Independent Telephone Company, of which Thomas W. Finucane is president, withdrawing in effect a former offer to take over the stock of the Rochester Company for cash. The circular releases the Rochester Company stockholders from existing option agreements, but allows them to exchange Rochester telephone stock for United States Independent stock if they so desire, thus putting all compensation in stock instead of in cash.

ASHEVILLE, N. C.—The Southern Bell Telephone & Telegraph Company has approved plans for a new exchange building in Asheville.

WINSTON, N. C.—A private telephone line 123 miles long has just been completed for Winston to the Washington cotton mills at Fries, Va., the line having connection with the Bell long-distance lines to New York.

CHESTER, PA.—Ground has been broken by the contractors for a new telephone exchange building of the Delaware & Atlantic Telephone Company.

DALLAS, PA.—The National Telephone Company has just completed the construction of some new lines in the neighborhood of Majorsville and Dallas, where it is preparing to establish a number of farmer lines. It will establish an exchange at Dallas. The company has commenced stringing ten copper wires from Pleasant Valley to West Alexander, where connections will be made with the exchange of the Claysville Telephone Company in that place.

MILLBANK, S. D.—The Grant County Telephone Company will build 135 miles of new line.

ABERDEEN, S. D.—The Dakota Central Company contemplates stringing a direct circuit between this city and Fargo, and another between this city, Watertown and Minneapolis.

NASHVILLE, TENN.—The Springfield Home Telephone Company, of Robertson County, has been incorporated with a capital stock of $7,000. The incorporators are: John McMurray, A. L. Dorsey, B. C. Moore, G. S. Moore, Thomas Pitt, H. T. Stratton, Jr., and H. C. True.

DALLAS, TEX.—The Texas Long Distance Consolidated Telephone Company has amended its charter, increasing its capital stock from $120,000 to $240,000.

WALLA WALLA, WASH.—A franchise has been granted to the Automatic Telephone Company.

WALLA WALLA, WASH.—There is a strong senitment here against the granting of a franchise for a second telephone system. The Commercial Club has entered a protest and it is proposed to call a meeting of business men for the purpose of petitioning the mayor to withhold his signature from the ordinance granting a franchise to the Home Telephone Company.

BALDWIN, WIS.—A franchise has been granted to the Rush River and Eau Calle Telephone Company.

MILWAUKEE, WIS.—Preparations are being made by the Wisconsin Telephone Company to install 10,000 more telephones next year. The Washington Street exchange, Milwaukee, will be enlarged and a new exchange opened at St. Martins.

LAS VEGAS, NEW MEX.—The Colorado Telephone Company will erect a new exchange in this place.

AMHERST, N. B.—The Cumberland Telephone Company was sold under the hammer recently and was bought by Dr. C. W. Hewson, who paid $14,000 for the property. It is stated that a company has been formed to carry on the business.

VANCOUVER, B. C.—The Home Telegraph & Telephone Company has applied to the City Council for a franchise, and offers the city 1 per cent. of the total receipts and 35 free telephones. The wires will be laid underground if the franchise is granted. The charges will be $4 per month for business houses and $2 per month for residences. The British Columbia Telephone Company will build a new exchange in this city.

Electric Light and Power.

JASPER, ALA.—The Jasper Light & Power Company proposes to install a new engine and a 75-kw generator.

MONTGOMERY, ALA.—The Citizens Light, Heat & Power Company contemplates installing a 500-kw, 2,200-volt alternator with Corliss engine or turbine to drive the same. P. P. Whiting is manager.

EUREKA, CAL.—The North Mountain Power Company proposes constructing a 5,000-hp hydraulic plant.

LOYALTON, CAL.—The Loyalton Electric Light Company has in contemplation extensive improvements, requiring a plant of 5,500 to 10,000-hp water power.

LOS ANGELES, CAL.—The Inner Harbor Gas & Electric Company has been incorporated with a capital stock of $200,000. The directors are: C. J. Walker, H. S. Farnsworth, W. B. Redbyrrn, H. T. Cooley and others.

RIO VISTA, CAL.—Application has been made to the board of town trustees for an electric light franchise for a term of 20 years from Jan. 1, 1906. Bids for said franchise will be received until Dec. 28 by F. J. Kalber, Town Clerk.

SAN FRANCISCO, CAL.—N. W. Halsey, of the New York banking firm of N. W. Halsey & Company, now here, authorizes the statement that there is no doubt that all of the conditions will be fulfilled to make effective the proposed deal consolidating the San Francisco Gas & Electric Company and the California Gas & Electric Corporation under the name of the Pacific Gas & Electric Company.

SAN FRANCISCO, CAL.—The Westinghouse Electric & Manufacturing Company has closed contracts to supply a number of special direct-current, 150-volt motors, which are to be direct connected to gas engines made by the Union Gas Engine Company, of San Francisco, these generating sets to be used by the Navy Department in the numerous wireless telegraph stations to be established along the coast from Bremerton, Wash., to San Diego, Cal. There will be one 15-hp motor, two tens, three fives and two threes.

VISALIA, CAL.—The Mount Whitney Power Company has closed a contract, through Hunt, Mirk & Co., of San Francisco, for a 1,000-kw, 3-phase Westinghouse-Parsons turbo-generator and all other equipment necessary for a complete steam reserve plant, to be installed at Visalia. Boilers, condensers and transformers are included, the contract price being about $100,000. This plant will be operated five months of the year, during the dry season, as an auxiliary to the company's two water-power electric plants. A transmission line about 35 miles long will be constructed connecting with the existing lines.

SAN FRANCISCO, CAL.—The Northern California Power Company, which has been constructing a new pole line from De Lar Mar, Cal., to Kennett, has sent a force of men to Tehama to commence work on a transmission line from that point to the Volta power station, near Shingletown, Shasta County. The construction of this 50-mile line will require considerable time. The fact that this water power concern was one of a very few which passed through the late prolonged dry season without serious water shortage, has had a beneficial influence, and it is rumored that a deal is on hand with the California Gas & Electric Corporation that will help this company.

SAN FRANCISCO, CAL.—The California Gas & Electric Corporation has closed contracts for a quantity of power station equipment, needed for its extensions during the coming year. Three direct-connected 5,500-kw., 220-volt, 3-phase, 60-cycle generating units are included, with direct-connected water wheels. The additional unit to be installed at the Centerville power station will consist of a 5,500-kw., 400 r.p.m. generator and an Allis-Chalmers Francis wheel, operating head 550 ft. Seven miles of ditch will be enlarged to conduct additional water from the De Sabla power house for use at the Centerville plant. The new unit for the Colgate power station will be a Westinghouse 5,500-kw., 300-r.p.m. generator and a Doble impulse wheel, operating head 660 ft. This will replace a 133-cycle unit. The third 5,500-kw. unit will be installed in a new power plant to be installed on Deer Creek, near Nevada City. It will consist of a Westinghouse generator of 300 r.p.m. and a Pelton wheel, operating head 785 ft. Water will be taken from the South Yuba Water Company's ditch system, and the plant is to be in operation by Aug. 1, next. Ten miles of transmission line will be constructed to enable the new power station to tie in with the lines from Colgate and Centerville. Stanley transformers of sufficient capacity for the new generators will be used to step up to the line voltage. Those to be installed at Deer Creek and Centerville will be built in 2,000-kilowatt units. These accessions, with the gas-engine reserve plant near San Francisco and the steam plant acquired with the San Francisco Gas & Electric Company, will place the transmission lines in position to give a much better service next summer.

DENVER, COL.—The Continental Mine, Power & Reduction Company proposes to construct in the spring a power plant to cost from $50,000 to $75,000, and a tunnel at a probable cost of $200,000. Capt. Henry I. Seemann, of Denver, is interested.

NEW HAVEN, CONN.—Regarding the new contract with the United Illuminating Company for lighting, the only changes announced are in the number of lights and the price. Under the contract which is about to expire 574 lights have been supplied at a price of $82.12½ per light per year, making a total of $47,057.62 for the lighting for each year. The new contract proposes that the city have 600 lights in operation by July 1 next. The company will agree to furnish the power for these lights at $78.47½ per year per light, a reduction on an individual light of $3.65. This will make the total cost under the new contract $47,084.99 per year, or an increase of $27.37 only for 26 new lights supplied.

NEW HAVEN, CONN.—The Board of Aldermen has considered a plan for purchase of the United Illuminating Company's plant in this city and then tabled the resolution. The matter came up on a favorable report for the execution of the new contract with the United Illuminating Company for the city's electric lighting and then Alderman Healey put in a resolution in favor of purchasing the plant. Alderman Curtiss explained that a new plant would cost between $240,000 and $300,000, or from $400 to $500 per light. It was estimated that with its own plant the city could furnish lights for $38,000 or $40,000, but he thought the present contract was very favorable and the best for the city. The money in the lighting business was made from the incandescent lights and not from the arcs. He said he did not believe the plant was for sale. The entire report was then tabled for printing.

TALLAPOOSA, GA.—Bonds to the amount of $10,000 have been voted for an electric light plant for this town.

ALBANY, GA.—Electrical pumps and motors are being installed in the city water and light plant here, to supplant steam apparatus. With the changes in progress the city will duplicate the steam and electrically-driven plants.

AUGUSTA, GA.—The City Council on Dec. 4 passed a resolution to investigate the advisability of the city constructing its own electric light plant, to be completed the time the present contract expires. Address, Nisbet Wingfield, City Engineer.

SAVANNAH, GA.—The Savannah Electric Company has given an order for an 800-kw. generating unit, and plans have been made for the building of an extension to the Indian Street station of the company, where power for the operation of the street railway system will be generated. At the present time railway power comes from the Bolton Street station, but it is the purpose of the company to combine the two plants, when the Bolton Street station will be shut down. The new apparatus in the extension will represent an investment of over $100,000.

MOSCOW, IDAHO.—The Moscow Electric Light & Power Company is contemplating the extension of its power line from the main line at the Lewiston Water Power Company's plant to and through neighboring towns.

JACKSONVILLE, ILL.—This city contemplates enlarging its municipal electric lighting plant, including the installation of generators and engines.

ANDREWS, IND.—Nichola & Thornton have secured a franchise for an electric light plant and water works.

JASPER, IND.—It is proposed to install at the municipal electric light plant a new 50-kw alternating dynamo. Jos. P. Kunkel is the purchasing agent.

MICHIGAN CITY, IND.—The Michigan City Light & Power Company has filed articles of incorporation with a capital stock of $150,000. Robert Garrettson, J. M. Garrettson and J. A. Garrettson are the incorporators.

TERRE HAUTE, IND.—At a meeting of the City Council Dec. 6, to consider a remonstrance against the construction of a municipal lighting plant at this time, the council voted to go ahead with the proposition and bids will be solicited at once.

OSAWATOMIE, KAN.—The Osawatomie Light & Power Company proposes to construct an electric light plant at a cost of about $10,000. It will add an ice plant later on.

PLAQUEMINE, LA.—The electric light plant which has been in the course of construction here for some months past, but was delayed on account of the quarantines, has been completed and the town is now electrically lighted.

PRESQUE ISLE, ME.—Things are looking very promising for Mr. A. R. Gould and those associated with him in the enterprise of developing the Aroostook Falls water power. There will be an extensive demand for the power for lighting and mechanical purposes from such points as Monticello, Bridgewater, Blaine, Mars Hill, Sprague's Mill, Fort Fairfield, Presque Isle, Limestone and Van Buren.

GARDNER, MASS.—The Gardner Electric Light Company is adding a Diesel gas engine to its equipment, installed by the American Diesel Company, of New York.

QUINCY, MASS.—An order favoring a municipal lighting plant in Quincy was reported by the special committee on the subject at the last meeting of the City Council, and was laid on the table. The order authorizes the city "to construct, purchase, lease or maintain one or more plants for the manufacture and distribution of gas and electricity for light, heat and power, except for the operation of cars, for municipal use and the use of the inhabitants of the city." Under the law, to become operative such an order must be passed by a two-thirds vote of two successive city councils, and then be submitted to the voters at a city election.

COLDWATER, MICH.—It is proposed to install a 50-hp compound engine at the municipal electric light plant. John A. Cavanagh is superintendent.

LANSING, MICH.—The ordinance granting to W. L. Haag the use of the streets for the purpose of installing poles and wires for furnishing electric power has been passed by the Council. A section provides that the city shall have a right to purchase all of the rights and privileges at the expiration of the franchise.

GRAND RAPIDS, MICH.—It is expected that the Grand Rapids-Muskegon Water Power Company will ask the Common Council for a franchise to deliver power within the city limits. The work of setting poles and the erection of a power house has so far advanced that the company, it is said, will be able to deliver power by February 1.

GRAND RAPIDS, MICH.—Because the Thornapple Electric Company does not see its way clear to accept the amendments which the ordinance committee of the Common Council has attached to the franchise granted to that company a year ago, there is now danger of legal complications arising. The amendments require that the company shall pay an ultimate maximum fee of $500 per annum and that power shall actually be delivered in the city within two years from May 1, 1906.

ABERDEEN, MISS.—This city will, in a short time, be in the market for a 200-kw., 60-cycle alternator. J. M. Acker is mayor.

GRENADA, MISS.—The City Council has decided to issue $30,000 bonds, to be used for improving the streets and the water works sewerage and electric light plant.

KIRKSVILLE, MO.—The Kirksville Gas, Heat & Electric Company has been incorporated with a capital of $30,000 by Fred. Grassie, Chas. Sands, and others.

INDEPENDENCE, MO.—The Jackson County Light, Heat and Power Company has been incorporated with a capital stock of $300,000. The incorporators are Thomas A. Rockwell, G. F. Goodney, W. F. Lyons and others.

JERSEY CITY, N. J.—The Jersey City Electric Company, with a capital of $250,000, has been incorporated by Frank W. Walton, Frank F. Geoff and H. W. Hedenberg.

JERSEY CITY, N. J.—The Luzerne Light, Heat & Power Company has been incorporated with a capital stock of $200,000. The incorporators are: Thomas H. Sheridan, Guy B. Hurlbut and Maturin Ballou.

KEARNEY, NEB.—The North-Western Electric Heat & Power Company has changed hands and it is stated that the plant will be enlarged and improved.

UNION, N. Y.—The citizens have voted to issue $15,000 bonds for the construction of an electric light plant.

NEWARK, N. Y.—The Niagara, Lockport & Ontario Power Company has secured franchises in Newark, Lyons and Clyde.

NIAGARA FALLS, N. Y.—Work has been commenced on the new transformer station near Lockport for the Niagara, Lockport & Ontario Power Company. The cost of this station will be $100,000.

SYRACUSE, N. Y.—The Syracuse Light & Equipment Company has been incorporated with a capital stock of $100,000. The directors are: William Darrone and C. E. Darrone, of Syracuse, and A. A. Buck, of New York.

TICONDEROGA, N. Y.—The Ticonderoga Electric Light & Power Company has applied to the State Electrical Commission for permission to issue $50,000 bonds. It is the intention of the company to construct, this fall, a steam plant at Burleigh dock.

CORINTH, N. Y.—The Corinth Electric Light Company has almost completed a wing dam on the Hudson River to which site the electrical equipment of the present steam plant will be moved about the first of the year. A general reduction in rates will follow and a day service for power purposes will probably be inaugurated in the near future.

CHARLOTTE, N. C.—The Catawba Power Company has completed a survey for a power line to Gastonia, 21 miles away. Other lines are also to be built and it is said that power will certainly be carried to Columbia, S. C.

NILES, OHIO.—Bonds to the amount of $20,000 have been issued for improving the electric light plant and water works.

HILLSBORO, OHIO.—The Hillsboro Light & Fuel Company is in the market for an engine and a 2,200-volt, 60-cycle, single-phase generator.

McMINNVILLE, ORE.—New bids will probably be called for in about 60 days for an electric light plant and water works, to cost from $60,000 to $80,000. W. M. Bostoph, Ogden, Utah, is the engineer.

PENDLETON, ORE.—The Forest Reserve Bureau has granted the Umatilla Electric Power Company a right of way through the Wenaha Forest reserve. The company will now proceed with the establishment of its power system, which includes the development of power on the North Fork of the Umatilla River.

ASHLAND, ORE.—Judge Hanna, of the Circuit Court of Oregon, has handed down a decision dissolving the temporary injunction against the Ashland Electric Light and Power Company, owned by the stockholders of the Siskiyou Electric Power Company, which was obtained by the city of Ashland, preventing the company from planting its poles within the city. In his decision Judge Hanna makes the dissolving of the temporary injunction permanent, gives costs and expenditures in favor of the company and declares that the electric company's franchise is perpetual, same having been obtained prior to the granting of the city's charter, which limits franchises to ten years.

HOMESTEAD, PA.—The Council has authorized the lighting committee to procure estimates of cost of constructing and maintaining a municipal electric light plant.

LAWRENCEBURG, TENN.—Kirkpatrick & Johnson, of Jackson, Miss., have been selected to prepare plans and supervise the construction of the municipal water works and electric light plant here. Jas. Dunn is city secretary-treasurer.

BEAUMONT, TEX.—Emmett Landry will petition for an electric light franchise.

LEHI, UTAH.—A mass meeting of citizens was recently held, at which it was decided to ask the City Council to take steps toward issuing bonds to increase the holdings of the city in the Utah County Light & Power Company. It is proposed to increase the capitalization to $200,000 and to enlarge the capacity of the plant.

SHENANDOAH, VA.—Geo. Cadogan Morgan, 169 Jackson Boulevard, Chicago, Ill., will be engineer in charge of the construction of the combined water works and electric light plant at Shenandoah. Bids for material and machinery will be received by A. R. Martin, town clerk, until Jan. 2.

FAIRBANKS, WASH.—The Tanana Electric Company has started the operation of its plant on the Chatanika River, 25 miles from Fairbanks. The occasion was marked by enthusiastic ceremonies.

LA CROSSE, WIS.—The La Crosse Hydro-Electric Light & Power Company has filed articles of incorporation at Madison. The company has a capital of $1,000,000, and has a State charter granting it rights to erect and maintain a water power plant near Black River Falls. It will expend about $750,000 in the construction of a dam. Power will be transmitted to La Crosse, a distance of about 55 miles. Orlando Holway, E. G. Boynton and Roy E. Bingham, all of La Crosse, are the incorporators.

BASIN, WYO.—A franchise has been granted by the City Council for an electric light plant, and the company which is promoting the project will soon be organized. The incorporators will be Josiah Cook, G. W. Richardson, Barnette G. Rogers, Lewis Zane, C. A. Cook, F. I. Rue, Simion Cockins, C. A. Zaring, W. J. Booth and W. S. Collins. The company will be capitalized at $50,000.

COBOURG, ONT.—The Northumberland-Durham Power Company is reported incorporated with a capital of $750,000 by W. J. Crossen, J. A. Culverwell, Chas. Donnelly, and others, to develop the water power of Healy Falls.

OWEN SOUND, ONT.—This city is figuring on installing at the municipal electric light plant a 300-kw, 3-phase generator, driven by engine direct, and three new boilers. Jos. McLinden is superintendent and chief electrician.

The Electric Railway.

SAN FRANCISCO, CAL.—The Public Utilities and Finance Committees have chosen a site at Geary and Baker Streets for the power house of the proposed municipal street railway on Geary Street.

VENTURA, CAL.—The Independent Railroad Company is planning to build an electric railway from Ventura through Casitas Pass to Santa Barbara. The officers of the company are R. A. Phillips, president; George Lemcke, first vice-president; E. C. Herlow, second vice-president; and H. W. Lemcke, general manager.

NORWICH, CONN.—The work of building the Norwich-Stonington Electric Railway is now under way. Much of the line is over private right of way.

THAMESVILLE, CONN.—The Consolidated Railway Company is considering an important proposition to centralize the electrical plants for the four divisions in Southeastern Connecticut, comprising the Norwich and Willimantic, the Norwich street railway, the Montville street railway and the New London street railway systems, by substituting one central generating station at Thamesville. The change is in the interests of centralization and economy.

AUGUSTA, GA.—Jas. U. Jackson and the syndicate which he represents have taken over the properties of the Augusta electric railway system and the Augusta-Aiken electric line, from the Williams-Middendorf interests, the deal involving $5,000,000. The Aiken line, it is said, will be extended to Columbia, S. C., at once.

EDWARDSVILLE, ILL.—At the meeting of the Edwardsville City Council, an ordinance was presented by the McKinley syndicate, which is constructing the interurban railway from Springfield to St. Louis through Edwardsville, asking for an extended franchise to construct and operate an electric light, gas and heating plant in the city and fixing the minimum rates to be charged for the commodities.

INDIANAPOLIS, IND.—The Indianapolis & Frankfort Traction Company has filed articles of incorporation. Albert Pierson, Frank C. Gaven and Theodore P. Davis are the incorporators.

DARLINGTON, IND.—A movement has been started to build an interurban railway from Terre Haute to Kokomo, via Darlington and Frankfort. P. M. Dunn, of Indianapolis, and H. C. Woody, of Darlington, are active in the undertaking.

LOUISVILLE, KY.—In an effort to organize a company to build an electric railway from Utica, Ind., to the line of the Louisville & Southern Indiana Traction Company, connecting Jeffersonville and Jasper, Ind., Ebenezer Howes, of Utica, is interested. The proposed line is to be eight miles in length.

LANSING, MICH.—It is reported that the Lansing & Suburban Traction Company will purchase the property of the Michigan Traction Company, including the suburban line between Battle Creek and Kalamazoo and the city lines in both Battle Creek and Kalamazoo.

SPRINGFIELD, MO.—The Springfield Traction Company, which has the only street railway in the city, has been sold to the McKinley syndicate and will be extended to Joplin. Col. T. H. Murray, W. B. Sanford and H. B. McDaniel, local capitalists, recently obtained control of about 375,000 of the 400,000 shares of stock.

CAMDEN, N. J.—The Lexington & Interurban Railway Company has been incorporated here with a capital of $4,000,000. The incorporators are: John A. MacPeak, F. R. Housell and George H. B. Martin.

SPRINGFIELD, OHIO.—The proposed sale of the Springfield, South Charleston, Washington C. H. and Chillicothe Traction Company has been postponed until Dec. 28 at the request of the reorganization committee. A number of the creditors have accepted the reorganization plan, which involves issuing bonds to pay off debts and finish the road.

SEELEYVILLE, PA.—W. A. Heller, of Danville, Pa., is promoting an electric street railway between Seeleyville and Hawley. The new road will be known as the Honesville & Hawley Electric Railway, and will be 12 miles in length, the power plant being at Honesdale. A charter will shortly be applied for.

SOUTH BETHLEHEM, PA.—A charter for an electric railway from South Bethlehem to Centre Valley has been secured by C. P. Hoffman, A. L. Cope and W. H. Lauer, of this borough, and the new line will be connected with the Philadelphia & Lehigh Valley Traction Company's line at Centre Valley. As connection will be made with the Easton Transit Company's line at Bethlehem, a new route will be formed between Philadelphia and Easton.

KNOXVILLE, TENN.—The Knoxville & Maryville Electric Railway Company, with a capital stock of $100,000, has been incorporated by W. S. Nash, Robert Vester, Joseph P. Gant, W. T. Parham, J. C. Sterchi, J. Burger and Haywood Garrick.

SALT LAKE CITY, UTAH.—Fred G. Palmer, of this city, has asked the City Council for a franchise for the construction of an electric railway from this city to Garfield, where a large smelter plant is in course of construction. Garfield is about 18 miles distant from the city.

NEWPORT NEWS, VA.—Negotiations between representatives of the Hampton Roads Traction Company, which acquired the property of the Hampton Roads Railway & Electric Company at the recent foreclosure sale made by the United States Court, and W. J. Payne, president of the Newport News & Old Point Railway & Electric Company were concluded a few days ago the control and management of that property, consisting of about 22 miles of electric railway lines, was turned over to the latter. For about two years the Hampton Roads Railway & Electric Company was in the hands of receivers. The conclusion of this fight leaves the Newport News & Old Point Railway & Electric Company in entire control of the railway and lighting situation in this territory.

New Industrial Companies.

THE C. E. COOK ELECTRIC COMPANY has been formed at Los Angeles, Cal., with a capital stock of $25,000. The directors are C. E. Cook, W. J. Schugart, of Whitney, and A. St. Clair Perry, of Los Angeles.

THE NASH ELECTRICAL SUPPLY COMPANY has been incorporated at Santa Fe, New Mex., with a capital stock of $15,000, all subscribed. The incorporators are: M. Nash, Kittie Nash and Carl Gilman, all of Albuquerque.

THE INFALLIBLE ALARM COMPANY, of North Collins, N. Y., has been incorporated, to manufacture fire and burglar alarms. The capital stock is $50,000, and the directors are: O. D. Graham, G. H. Davis and W. G. Lyman, of North Collins.

Legal.

BOSTON DAMAGES.—The city of Boston has been ordered to pay to the Boston Electric Light Company the sum of $307,720.02 as damages for interference with the petitioner's place of business. The case has been on trial for several days and the plaintiffs say that for city improvements the city authorities deprived them of valuable water front which they possessed on 1st Street, South Boston.

MOVING STAIRWAYS.—A suit for infringement of patent brought by Charles D. Seeberger for moving hand rails on moving stairways, against the Reno Inclined Elevator Company, was decided December 1, when Judge Wallace granted an injunction to the complainants restraining the defendant from further manufacture of the moving hand rail, pending the result of an appeal. The original suit brought by Mr. Seeberger is based upon rights acquired by him on the patent, No. 479,864, granted August 13, 1892. The suit for infringement against the Reno Company was originally instituted in June, 1902.

Educational.

UNIVERSITY OF WASHINGTON.—Special evening lectures are being given by the Department of Electrical Engineering of the University of Washington during 1905-6 on electrical subjects. These will be included in the field covered by the semester examinations and are as follows: Electric Traction by Mr. Elbert G. Allen, M. S. (Mass. Inst. of Tech.), Chief Electrical Engineer, Seattle Electric Company. Dec. 4, "Traction Dynamics." Dec. 11, "Train Movement." Dec. 18, "Generating and Sub-Stations for Electric Railways." Jan. 8, "Power Distribution for Electric Railway." Jan. 15, "Railway Economics." Central Station Practice by Mr. J. D. Ross, Chief Electrical Engineer, Seattle Municipal Electric Light & Power System. Feb. 5, "Central Station Organization, Management and Records." Feb. 12, "Switchboards." Feb. 19, "Metering." Feb. 26, "Arc-Lighting." March 5, "Tests, Repairs and Trouble Work." Electric Power Transmission by Mr. John Harisberger, Chief Electrical Engineer Seattle-Tacoma Power Company. Apr. 30, "Source of Power." May 7, "Prime Movers." May 14, "Apparatus for Generating Electric Power." May 21, "The Transmission Line." May 28, "The Receiving Stations and Distributing Lines."

Personal.

JAS. A. WOTTON.

MR. JAMES ASHLEY WOTTON was born in Charleston, S. C., October 30, 1861, where he attended private schools until he entered the University of Georgia at Athens, Ga., in 1879, graduating with the degree of B. C. S. in 1882. From 1880 to 1883 he held the position of assistant state chemist, from which he resigned in 1883 to accept a position with the Southern Bell Telephone & Telegraph Company, at Atlanta, Ga. The company at that time was just beginning to establish itself in the Southern States. With this company he rose by successive steps to be manager of the shops, electrician and chief electrical engineer, remaining with them until 1900. During this time Mr. Wotton was an important factor in the general development of the telephone business throughout the South, his inventive genius having contributed to the production of many of the essential features of the apparatus of the present day. In this his knowledge of chemistry often played an important part. In 1900 he was called to New York as assistant electrician for the American Telephone & Telegraph Company, resigning from this position later to enter the independent telephone field as a manufacturer. In this latter role he became identified, as chief engineer, with the Wotton Electric & Manufacturing Company, located at Atlanta, Ga., and was engaged in the manufacture and sale of telephone equipments of all description. This company was in the early spring of 1905 merged into the Electric Manufacturing & Equipment Company, formed to manufacture telephone equipments under Mr. Wotton's design and patents, with which company he now holds the position of chief engineer. Mr. Wotton is a full member of the American Institute of Electrical Engineers.

MR. C. E. BRADSHAW, the city electrician of Charlotte, N. C., was a recent visitor to New York City, and attended the meeting of the Fire Underwriters.

DR. A. C. HUMPHREYS, President of Stevens Institute of Technology, has been elected a director of the Equitable Life Assurance Company under the new regime.

MR. J. A. BRETT, formerly of the Chicago office of the Westinghouse Electric & Manufacturing Company, has been made manager of the Cincinnati office of that company.

MR. ROBERT S. CLEMONS, recently of the Crocker-Wheeler Company, has become associated with Dodge & Day, of Philadelphia, as a specialist in power-house construction.

MR. JOSEPH SACHS, of enclosed fuse fame, has resigned from the Johns Pratt Company, and severed his connection with Noarc interests. He has become president of the Arknot Company, of Hartford, Conn.

MR. GEORGE N. EASTMAN, chief of the testing department of the Chicago Edison Company, who has been obliged to temporarily give up his duties on account of his health, is now in California, and his friends will be glad to learn of encouraging reports as to his improvement in health.

MR. T. R. MERCEIN, secretary of the Northwestern Electrical Association and general manager of the Electrical Trades Exposition Company, of Chicago, has been in New York during the past week on matters connected with the Chicago Show to be held next January. He counts on making a considerable success.

MR. J. G. WHITE. head of the large engineering interests in America and England bearing his name, returned last week from England, and will spend the winter in New York. He speaks very hopefully of financial and industrial conditions in England, as well as of the important engineering projects now being carried out under White management in various parts of the world.

MR. A. B. CONOVER has been elected treasurer and general manager of the John A. Roebling's Sons Company to fill the vacancy caused by the death of Mr. George C. Bailey. Mr. Conover has been connected with the Chicago office of the company for the past 18 years. About a year ago he was appointed general sales agent during Mr. Bailey's absence on account of sickness.

MR. J. J. MYER, for several years representative of the Columbia Incandescent Lamp Company in Indiana and who recently represented the Sawyer-Man Company in the Eastern territory, has returned to the Columbia Company and now has charge of the business of that company in Texas. Mr. Myer willl make his headquarters at Dallas, and will look after the company's interest in Louisana as well as Texas.

MR. HAMILTON KILGOUR, the well-known English electrical engineer, and joint author of the Geipel & Kilgour "Electrical Pocket Book," is now visiting the United States to study American power house and electric railway construction. He hopes to spend about three months on this side of

the Atlantic. Mr. Kilgour has had a long practical experience as electrical engineer to the Cheltenham Corporation.

MR. HARRY C. GOLDRICK has become the representative of the Kellogg Switchboard & Supply Company in the Central Southern States. He has a wide acquaintance in the independent telephone field and the electrical trade and was with the independent telephone company in Indianapolis for seven years. He has had an extensive experience in the construction, installation, maintenance and operating departments. He is an associate member of the American Institute of Electrical Engineers. His territory for the Kellogg interests will include Kentucky, Tennessee, Alabama and Mississippi.

MR. E. P. COLEMAN has resigned as general manager of the Consolidated Lighting Company, of Montpelier, Vt., his clients having sold their interest in the property. He has opened an office in the Vermont Mutual Building, Montpelier, and is now in a position to give attention to mechanical and electrical engineering of all kinds, especially physical and financial examinations of central station properties. He has also formed an affiliation with one of the foremost mill engineering firms of New England, and is prepared to plan and superintend the construction or alteration of electric power stations, mills and manufactories of every description.

MR. J. D. ROCKEFELLER, JR., is said to be interested as president of the Continental-Mexican Rubber Company in the production of rubber. The company is erecting a factory at Torreon, Mexico, to manufacture rubber from the guayule plant. It is stated that the factory will cost more than one million dollars and will be the largest of its kind in Mexico. It was less than two years ago that the discovery was made that a certain quality of rubber can be manufactured from the guayule plant, which grows in its wild state, and in great abundance all over the plateaus of Northern Mexico. Several factories for utilizing the plant have already been established and are turning out large quantities of the product.

MR. JOHN W. LIEB, JR., gave a luncheon at Delmonico's, last week, on December 9, to Mayor and Mrs. Barnard, of Asheville, N. C., whose personal attentions and efforts contributed so much to the success of the meeting of the American Institute of Electrical Engineers last June, in the North Carolina health resort. Among those present at this enjoyable reunion to meet Mr. and Mrs. Barnard were Mrs. J. W. Lieb, Jr.; Mr. and Mrs. F. C. Bates, Secretary R. W. Pope, Mr. A. Williams, Mr. Calvin W. Rice and Mr. T. C. Martin, most of whom had participated actively in the Asheville convention, over which Mr. Lieb had presided and which had constituted a notable event in institute history. A member of the party also was Mr. Chas. E. Waddell, chairman of the Institute Committee at Asheville. On Tuesday, December 9, a little dinner was given Mr. Waddell at the Café Martin, after which hosts and guest adjourned to attend the opening of the Electrical Show in Madison Square Garden.

Trade Publications.

CHEMICALS FOR TECHNICAL WORK.—The J. T. Baker Chemical Company, Easton, Pa., has issued a price list of analyzed chemicals for laboratory and technical work.

KELLOGG SWITCHBOARD & SUPPLY COMPANY is issuing neat souvenir postal cards showing Kellogg apparatus to be the "gold standard" of telephony. The cards are printed in colors and gold.

"LIVE WIRE" is the title of a publication issued monthly by the Wesco Supply Company, of St. Louis, as a house organ. It is entering upon its third year of publication, and has a regular mailing list of 1,200 buyers of electrical goods. The circulation is in the territory of the Wesco Company, including the vast and prosperous region south of the Ohio River and west of the eastern boundary of Indiana. Its "Want Ad" columns are free to readers and there is no subscription price charged. It is a quarto publication, handsomely got up, illustrated, and full of good, bright matter.

GASOLINE MOTOR CARS FOR RAILWAY WORK.—Catalogue No. 101 A of Fairbanks, Morse & Co., Chicago, describes Sheffield gasoline motor cars for railway work. These cars are similar in some respects to automobiles, but are designed for operation on standard railway tracks. They are built in all sizes from a small tool car to a passenger omnibus. An interesting equipment is a gasoline trolley repair motor car designed for repair work on electric roads. The tower is made in two sections, the upper of which is telescoped into the lower when traveling over the line.

News of the Trade.

JANDUS ELECTRIC COMPANY, Cleveland, Ohio, moved its offices recently up to its factory. This has improved facilities for controlling closely the work in the factory. At the same it has taken more space in the building it occupies, so as to largely increase its capacity. The move was made necessary by the growth of its business.

THE AMERICAN ARC LAMP COMPANY, Kalamazoo, Mich., which manufactures the American enclosed arc lamp that was so well known for some years as the Lea lamp, says that its November sales exceeded anything in the history of the lamp, both in amount and the territory covered, while the outlook at the beginning of December was very flattering.

HOLTZER-CABOT ELECTRIC COMPANY, of Brookline, Mass., in order to concentrate its business, is closing up its New York offices, and requests that hereafter all communications in the locality named be addressed to the Brookline headquarters. It is believed that this method of dealing directly will facilitate greatly the execution or orders. Business is very good and growing.

THE CURTIS & CURTIS COMPANY, of Bridgeport, Conn., manufacturer of pipe cutting and threading machinery, has just opened a large store at 60 Centre St., New York City, where a full line of its pipe cutting and threading machines will be on exhibition and can be seen in operation. Mr. H. H. Walker will be in charge. He will be pleased to receive calls from any one interested in this class of machinery and will demonstrate the many advantages possessed by this make of machines.

TESTS OF TRANSFORMERS.—A very interesting exhibit is to be held at the Madison Square Garden at the present electrical show, whereby the Electro-Dynamic Company will show actual tests of the Moloney transformers. These tests will be made before engineers or customers, and will show the low copper losses and other interesting data. The experiment is made with all the necessary instruments. Such an exhibit as this is not only convincing but also instructive, and illustrates the latest methods for testing the various efficiencies of transformers.

STERLING MOTOR COMPANY.—From December 1, the Eastern office of the Sterling Electric Motor Company will be at 143 Liberty Street, New York City, Mr. Allen, formerly consulting electrical engineer of the Marine Engine & Machine Company, and Mr. J. J. Estabrook and others have formed a company called The Engineering Specialty Company, which will have the handling of the Sterling machines in that territory. Mr. Estabrook was formerly manager of the New York office for Holtzer-Cabot Electric Company. The new firm is well equipped to cover the field for the Sterling line. A complete stock of machinery will be kept at the New York end for immediate delivery in that territory.

THE POWER IMPROVEMENT COMPANY, of Milwaukee, has been incorporated under the laws of the State of Wisconsin. Mr. George P. Dravo is president, Mr. James Drought, vice-president; Mr. Andrew Pinkerton, secretary and treasurer. Mr. Dravo is a mechanical engineer with many years' experience, and Mr. Pinkerton has been for 11 years electrical engineer for the American Sheet & Tin Plate Company (formerly Apollo Iron & Steel Company) and also for the Vandergrift Electric Light & Power Company and for the Vandergrift Telephone Company. Prior to his engagement with the Apollo Company, he was on the engineering staff of Siemens Bros. & Co., of London, England. The firm will practice as industrial and commercial engineers and is prepared to make examinations and reports on new propositions and also on the betterment of existing plants. The company took over the agency relations of Mr. Dravo of the De Laval Steam Turbine Co. and the Foster Superheaters.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED DEC. 5, 1905.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

806,107. COMBINED SOCKET AND ROSETTE; Walter A. Church, Binghamton, N. Y. App. filed Dec. 6, 1902. Details.

806,150. ELECTRIC AND PNEUMATIC GOVERNOR; Thomas F. Kelly, Philadelphia, Pa. App. filed Nov. 11, 1904. The usual diaphragm connected to the usual pressure reservoir has a compound lever attachment, one part of which releases a detent and allows the circuit closing members to fall, while the other arm has a contact wheel which makes connection with a sliding plate until the solenoid for breaking the main contacts has been raised sufficiently to be engaged by the detent.

806,152. THIRD-RAIL PROTECTOR; William H. Kober and Charles E. Watier, Lancaster, O. App. filed Mar. 6, 1905. An inverted L-shaped hood composed of alternate sheets or laminations of metal and insulating material, is supported over the usual third rail. The different plates and insulating sheets are lapped with respect to one another so as to be more effectively separated at their edges.

806,173. ELECTRIC FURNACE; Romaine W. Myers, Fruitvale, Cal. App. filed Feb. 14, 1905.

806,217. DYNAMO-ELECTRIC MACHINE; Henry H. Wait, Chicago, Ill. App. filed April 24, 1905. (See Current News and Notes.)

806,238. SIGNAL APPARATUS; Clarence W. Coleman, Westfield, N. J. App. filed July 1, 1905. A motor for operating semaphore signals comprising a base carrying a small bi-polar motor which is connected by reduction gearing with a crank pin which acts on a movable bar or cross head so as to produce harmonic motion thereof. Stop motions for the motor are provided at the ends of the movement.

806,248. TROLLEY; George R. Fletcher, Cambridge, O. App. filed May 31, 1905. A notched scraper blade has a pair of forked extremities which are supported by the usual trolley axle, and is spring pressed upward against the wire so as to remove the ice and sleet therefrom.

806,284. MOUTHPIECE ATTACHMENT FOR TELEPHONES; Metta Frances Hubbard Phillips and William Beck Hubbard, Boston, Mass. App. filed March 6, 1905.

806,310. TROLLEY WIRE HOLDER; Frank M. Zimmerman, Aurora, Ill. App. filed Mar. 21, 1905. Details of a trolley wire holder having a cylindrical cavity with ledges at its interior end adapted to receive a generally cone-shaped projection on the usual hanger.

806,318. AUTOMATIC PARALLELING DEVICE FOR ALTERNATING-CURRENT GENERATORS; George A. Burnham, Willimantic, Conn. App. filed Jan. 14, 1904. A transformer is connected to each generator. The secondary windings of these transformers are joined in a circuit with an electromagnetic switch around which there is a normally closed shunt, the switch serving to control the paralleling circuits.

806,319. AUTOMATIC SIGNAL; Andrew B. Burt and Frank T. Vanatta, San Francisco, Cal.. App. filed June 5, 1905. A section of rubber hose is laid alongside the track rail so as to be compressed by the tread of the wheel passing over it, and has pneumatic cylinders for closing a circuit at one or the other end, depending on the direction of movement of the wheel passing thereover.

806,325. AUTOMATIC PRESSURE CONTROL; John H. Crawford, Camden, N. J. App. filed Dec. 8, 1904. The regulating cylinder connected to the pressure reservoir has its piston attached to a leaf spring forming an

arm of the switch lever. The switch arm moves abruptly after a certain travel of the piston and its connected leaf spring.

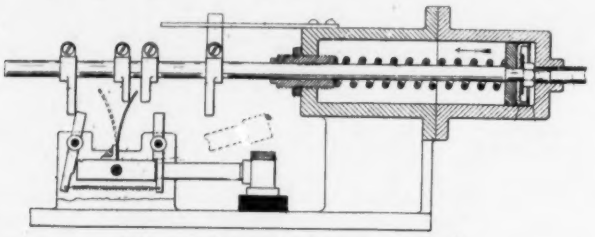
806,332. ELECTRIC CLOCK SYSTEM; Martin Fischer, Zurich, Switzerland. App. filed July 5, 1900. A small magneto generator adapted to transmit impulses periodically under trip connections from the mechanism of the master clock, and in order to reduce the inertia of the moving parts, the usual H armature is held stationary, and a magnetic shell moved so as to short circuit the lines of force therethrough.

806,339. TELEPHONE SHELF; Joseph S. Gold, Jackson, Ohio. App. filed May 20, 1904.

806,372. TELEPHONE ATTACHMENT; Joseph Silverman, San Francisco, Cal. App. filed May 26, 1905.

806,412. TELEGRAPH REPEATER; Francis W. Jones, New York, N. Y. App. filed Sept. 21, 1905. Both of the transmitting magnets are wound with three separate coils, one of which has its circuit broken by the break points of the receiving relay, the second coil being in a permanently closed local circuit, and the third coil having its polarity controlled by contact points on the opposite transmitter.

806,413. ELECTRODE FOR ELECTROLIZERS USED IN THE MANUFACTURE OF BLEACHING LIQUORS; Richard Kother, Cunewalde, Germany. App. filed Sept. 7, 1905.



806,325.—Automatic Pressure Controls.

806,430. TROLLEY SIGNAL; Benjamin H. Roberts, Haverhill, Mass. App. filed Oct. 5, 1905. Details of a system for single track trolley roads in which a ratchet is stepped around for every car that enters a block, and reversely moved whenever a car leaves the same.

806,442. ELECTRIC SWITCH OPERATING DEVICE; Ira J. Stouffer, Altoona, Pa. App. filed July 10, 1905. A contact shoe is hung alongside the usual conductor, so as to be charged by contact springs on the trolley pole. Two switch operating magnets are so connected by compound levers that one of them is effective to hold the switch point in its thrown relation until the other magnet has been energized.

806,462. AUTOMATIC CONTROLLER FOR ELECTRICALLY ACTUATED COMPRESSORS; Niels A. Christensen, Milwaukee, Wis. App. filed May 13, 1898. In order to avoid the destructive spark incident to breaking the motor circuit, the patentee has a fluid motor for operating the usual switch and provides an air blast directed against the contacts at the instant the circuit is broken.

806,477. WIRE CONNECTOR; Nathaniel W. Lillie, Somerville, Mass., and Anton Freier, Boston, Mass. App. filed Feb. 20, 1905. A strip of metal is shaped to join adjacent recesses to receive the wires, the metal being softer and more pliable in the middle than at the ends.

806,509. COMPOSITE INSULATOR; Louis Steinberger, New York, N. Y. App. filed Nov. 26, 1904. Comprises a hood provided with a portion threaded externally and with a ring spaced apart from this portion so as to leave a slot between, and a hood threaded internally so as to engage said portion and provided with an annular portion for entering said slot.

806,538. ELECTRIC SIGNAL FOR RAILWAYS; John B. Gorrell and Hiram V. Gorrell, Laotto, Ind. App. filed June 21, 1905. Circuits laid along the usual block section, including special semaphore signals by which a train may be flagged in case it inadvertently passes the main signals.

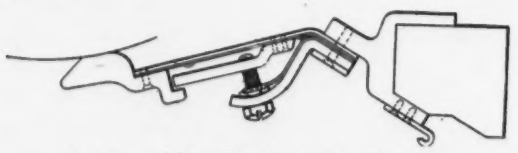
806,542. LOCKING OR BOLTING DOORS AND THE LIKE; Claude E. Hensley, Elreno, Oklahoma Ter. App. filed May 13, 1904. The locking bolts have compound multiplying lever connections with the magnetic trip so that the latter will release properly in spite of the friction and inertia of the heavy bolt mechanism and its impelling springs.

806,560. ELECTRICAL MEASURING INSTRUMENT; Edwin F. Northrup, Philadelphia, Pa. App. filed May 12, 1905. A method of measuring an alternating current which consists in passing current from the alternating current to be measured through one conductor and a direct current of comparison through another conductor, and adjusting the current through one of said conductors until the relative expansion of both conductors shows that the current value of the alternating current bears a known relation to that of the direct current of comparison.

806,568. ELECTRIC SWITCH FOR STREET RAILWAYS; James A. Posey, Midlothian, Texas. App. filed Jan. 21, 1905. Alongside the track rail is placed a depressible bearer with connections to the switch point. There are also a pair of contact plates for making an electrical circuit which renders said connections effective to move the switch point in a different way when the circuit is energized than otherwise.

806,573. MEANS FOR ASCERTAINING THE POWER FACTOR IN ALTERNATING-CURRENT SYSTEMS; Joseph Louis Routin, Lyon, France. App. filed Nov. 21, 1904. (See Current News and Notes.)

806,575. INSULATED WIRES; George H. Rupley, Schenectady, N. Y. App. filed Jan. 15, 1904. Method of coating wires with linseed oil which is afterward baked to the point of destructive distillation so as to leave an infusible residuum.



806,639.—Adjustable Controller Finger.

806,588. ELECTRICAL INSULATOR; Herbert Sinclair, Trenton, N. J. App. filed May 5, 1905. The body of the insulator is of oval cross-section, with the long axis of the oval in a plane perpendicular to the length of the wire groove. Corresponding notches are cut in the faces of the body and the cap to form a cross-groove for the wire.

806,600. PROCESS OF STERILIZING MILK AND OTHER LIQUIDS; Robert C. Turner, Columbus, O. App. filed Jan. 25, 1904. A method of sterilizing milk which consists in flowing the milk over a series of terraces or cascades and passing a current of electricity through the fluid streams for the momentary interval of their transition.

806,601. APPARATUS FOR STERILIZING MILK AND OTHER LIQUIDS; Robert C. Turner, Columbus, O. App. filed Mar. 16, 1904. An apparatus for carrying out the foregoing process involving insulating receptacles with electrode plates, and having spouts on their upper edges.

806,630. TROLLEY; Amos Bopp, Baltimore, Md. App. filed Mar. 25, 1905. The trolley wheel is vertically swiveled within a cage having two upper bearing rods or shoes, curved to prevent injury to the wheel in case it leaves the wire, by the guy ropes, trees, etc.

806,635. MOTOR CONTROL SYSTEM; Eugene R. Carichoff, East Orange, N. J. App. filed Aug. 4, 1904. A complete multiple unit control system having among other features a pair of locks operable from the controller and operatively connected to both the reversing and controlling switches, one of said locks being inoperative with respect to the reversing switch when the other is actuated.

806,636. ELECTROMAGNETIC VIBRATOR; Ragner Carlstedt, Jersey City, N. J. App. filed Aug. 22, 1904. A vibrator employing an H armature between two curved pole faces and having an ordinary circuit breaker to cause its vibration.

806,638. SIGNAL FOR SECTIONAL CONDUCTORS; Frank E. Case, Schenectady, N. Y. App. filed May 21, 1904. A system for indicating to a motorman whether either of two sections of the third rail ahead is grounded, and also whether the sections are at the same potential. A semaphore magnet is energized in case the rail sections are at a different potential or in case either one of them is grounded.

806,639. ADJUSTABLE CONTROLLER FINGER; Frank E. Case, Schenectady, N. Y. App. filed July 19, 1904. An adjustment for contact springs in which part of the usual spring is made use of for the purpose of adjustment and the remainder for the purpose of resiliency.

806,666. AUTOMATIC CIRCUIT BREAKER; Edward M. Hewlett, Schenectady, N. Y. App. filed Oct. 11, 1897. The circuit breaker has a plurality of tripping magnets in different circuits which act on a common trip so as to break the circuits at separate points, but employing a common blow-out magnet.

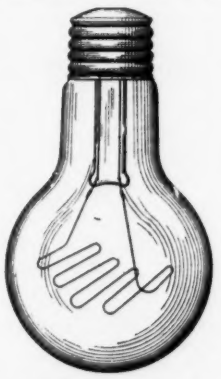
806,667. SYSTEM OF ELECTRIC GENERATION AND DISTRIBUTION; Edward M. Hewlett, Schenectady, N. Y. App. filed October 5, 1901. The system comprises a generating outfit, a sectional bus-bar, and a plurality of distribution units, each supplied by a plurality of feeders leading from different sections of the bus-bars.

806,694. INSTRUMENT FOR SUPPLYING CONSTANT CURRENTS OF HOT AIR; Victor Monath, Vienna, Austria-Hungary. App. filed May 25, 1903. A casing contains an incandescent wire past which a current of air flows so as to become heated when it issues from the nozzle.

806,696. METHOD OF INSULATING; Walter S. Moody, Schenectady, N. Y. App. filed Apr. 26, 1902. In order to insure the oil within a circuit breaker being perfectly free from air and moisture, the air is initially exhausted from the insulating chamber and the oil is flowed therein through a drying apparatus adapted to remove the water.

806,709. SWITCH OPERATING MECHANISM; Jesse S. Pevear, Schenectady, N. Y. App. filed Feb. 27, 1905. A pair of oil-bath switches are connected to respectively control current through alternating current and direct-current motors upon the car. The switches are arranged in transformer circuits in such a way as to automatically throw the proper switch by connections to direct or alternating power mains.

806,717. HIGH-VOLTAGE INSULATOR; George W. Thomas, East Liverpool, Ohio. App. filed Sept. 7, 1904. As a substitute for the wooden pin for a high-voltage insulator, a hollow glass or porcelain post is cemented to the body of the insulator, an iron bolt, which passes through the center of the post, serving to hold the insulator in place on the cross arm.



806,723.—Incandescent Electric Lamp.

806,723. INCANDESCENT ELECTRIC LAMP; James C. Wormley, New York, N. Y. App. filed Jan. 15, 1904. The filament is formed with a plurality of zig-zag bends, all lying in a single plane transverse to the axis of the lamp.

806,728. DEVICE FOR PREVENTING THE OVERCHARGING OF ELECTRIC CABLES; George Zapf, Cologne-Nippes, Germany. App. filed March 28, 1905.

806,733. MAGNETIC BLOW-OUT SWITCH; Charles E. Carpenter, New York, N. Y. App. filed Jan. 9, 1904. The final break of the circuit is made upon the surface of a roller contact and in proximity to a magnetic blow-out pole.

806,734. APPARATUS FOR STOPPING ELECTRIC MOTORS; Charles E. Carpenter, New York, N. Y. App. filed Apr. 29, 1904. In order to secure a uniform braking effect, the motor armature is connected into a closed circuit, including a heavy inductive resistance, the impedance of which prevents excessive current at the initial closure of the circuit.

806,735. ELECTRIC CONTROLLING AND REVERSING SWITCH; Charles E. Carpenter, New York, N. Y. App. filed Feb. 3, 1905. In order to prevent the controller arm being thrown too suddenly past its central position for the purpose of reversing the motor, a separately hand-manipulated stop is interposed, which is effective to stop the controller arm at center whichever way it happens to be moving.

806,745. ELEVATOR SYSTEM; George A. Le Fevre, Orangeburg, N. Y. App. filed Dec. 2, 1904. The elevator has a safety clutch operated by a solenoid magnet which is in circuit with the usual controller, so that the safety clutch is thrown into action whenever the main motor circuit is broken.

806,749. TRANSFORMING DEVICE FOR ELECTRIC CURRENTS; Jacob E. Noeggerath, Schenectady, N. Y. App. filed May 26, 1904.

806,751. SWITCH CONTROLLING MECHANISM; Jesse S. Pevear, Schenecady, N. Y. App. filed Feb. 27, 1905. Relates to details of an automatic switching mechanism for connecting different circuits to the mains according to whether they are supplied with direct or alternating current.

806,752. COMBINED ALTERNATING AND DIRECT-CURRENT CONTROL APPARATUS; Jesse S. Pevear, Schenectady, N. Y. App. filed May 8, 1905. Construction of a master switch or controller adapted to operate the motors either from a high-tension alternating current or from a low-tension direct current.

806,758. RESISTANCE FOR ELECTRICAL APPARATUS; Charles P. Steinmetz, Schenectady, N. Y. App. filed Jan. 21, 1903. (See Current News and Notes.)